GC30-3006-4
File No. S360/S370-30

Systems

Storage Estimates and Performance Planning for the IBM 3704 and 3705 Communications Controllers Network Control Program

IBM

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Storage Estimates and Performance Planning for the IBM 3704 and 3705 Communications Controllers Network Control Program

(for OS/TCAM, OS/VS TCAM, and OS/VS and DOS/VS VTAM Users)

IBM

Fifth Edition (July 1976)

This is a major revision of, and makes obsolete, GC30-3006-3. Changes or additions to the text and illustrations are indicated by a vertical line to the left of the change. Changes are described on the Summary of Changes page.

This edition applies to version 1 modification 3 (OS TCAM users), version 2 modification 3 (OS/VS TCAM users), and version 5 (DOS/VS, OS/VS1, and OS/VS2 VTAM users and OS/VS TCAM users) of the network control program and to all subsequent versions and modifications unless otherwise indicated in new editions or Technical Newsletters. It also applies to version 3 of the emulation program.

Changes are continually made to the information herein; before using this publication in connection with the operation of IBM systems, consult the latest *IBM System/360 Bibliography,* GC20-0360, or the latest *IBM System/370 Bibliography*, GC20-0001, and associated Technical Newsletters for the editions that are applicable and current.

Requests for copies of IBM publications should be made to your IBM representative or to the IBM branch office serving your locality.

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Preface

This publication is a guide to determining the storage requirements of the network control program, versions 1, 2, and 5 (NCP 1, NCP 2, and NCP 5). It is also a guide to help in the planning for the NCP's performance.

The publication is directed to systems analysts, system programmers, IBM systems engineers, and IBM salesmen who are planning for network control program storage estimates and performance.

Chapter 1 describes the organization of the manual and how it should be used to arrive at the storage and performance estimates for the network control program (NCP).

Chapter 2 shows how to determine total storage estimates for NCP 1 and NCP 2 by first determining the individual requirements for base and user code, line and device support, tables, control blocks, buffers, and optional system functions.

Chapter 3 shows how to determine total storage estimates for NCP 5 by first determining the individual requirements for base and user code, line and device support, tables, control blocks, buffers, and optional system functions.

Chapter 4 shows how to determine the total storage estimates for the emulation program portion of the NCP when the TYPGEN operand has been specified as PEP or EP.

Chapter 5 describes the NCP generation operands that affect performance; it is a guide to help you make knowledgeable performance tuning decisions when coding NCP parameters. Your IBM representative can help you plan for the performance of your communications controller.

Because of the wide variation among installations, this manual does not contain specific recommendations, assumptions, or conclusions about communications controller storage or performance. Instead, it contains information general enough to help most users according to the unique needs of their installation.

Prerequisite Publications:

IBM 3704 and 3705 Communications Controllers Network Control Program Generation and Utilities (for OS/MFT and OS/MVT TCAM Users), GC30-3000 (for the network control program, version 1)

IBM 3704 and 3705 Control Program Generation and Utilities Guide and Reference Manual, GC30-3007 (for the network control program/VS, version 2, and the emulation program/VS, version 2)

IBM 3704 and 3705 Control Program/VS Generation and Utilities Guide and Reference Manual, GC30-3008 (for the network control program/VS, version 5, and the emulation program/VS, version 3)

Related Publications:

DOS/VS VTAM System Programmer's Guide, GC27-6957

OS/VS1 VTAM System Programmer's Guide, GC27-6996

OS/VS2 System Programmer's Library: VTAM, GC28-0688

Summary of Changes for GC30-3006-2

Program Changes

This edition contained new storage and performance information pertaining to version 3 of the network control program for OS/VS and DOS/VS VTAM users.

Manual Changes

Emulation program storage values previously located in Chapter 2 were moved to Chapter 4.

A new chapter, Chapter 3, contained the storage estimates for NCP 3.

This manual also contained minor corrections and additions to the previous edition.

Summary of Changes for GC30-3006-3

Program Changes

This edition contained new storage estimate information pertaining to version 4, modification 1 of the network control program for OS/VS and DOS/VS VTAM users.

Manual Changes

This edition contained minor corrections and additions to the previous edition. It also contained two new appendixes, B and C, that contained additional buffer storage estimate calculations.

Summary of Changes for GC30-3006-4

Program Changes

This edition contains new storage estimate information pertaining to (1) version 5 of the network control program (NCP 5) for OS/VS and DOS/VS VTAM and for OS/VS TCAM and (2) version 3 of the emulation program/VS (EP 3).

Manual Changes

This edition deletes the detailed calculations for the NCP throughput tests (Chapter 5) and the line interrupt priority (Chapter 6). Specific performance information is available through the IBM representative servicing your account.

This manual also contains minor corrections and additions to the previous edition.

Contents

Figures

Chapter 1: Introduction

The purpose of this publication is to assist you in determining storage estimates for the network control programs and in planning for the performance of your teleprocessing subsystem. This manual applies to the first, second, and fifth versions of the network control program. The first version, referred to as NCP 1, pertains to the network control program in an OS/MFT and OS/MVT TCAM environment. The second version, referred to as NCP 2, is for operation in an OS/VS TCAM environment. The fifth version, referred to as NCP 5, is for operation in a DOS/VS, an OS/VS1, or an OS/VS2 VTAM user's environment and in an OS/VS TCAM user's environment. NCP 5 supersedes the fourth version, NCP 4.

Calculating Storage for NCP 1

The first version (NCP 1) allows the communications controller to operate in network control program mode only. Determine the storage estimates for this program by adding together the various estimates in Chapter 2.

Calculating Storage for NCP 2

The second version (NCP 2) allows the communications controller to operate in either emulation mode or network control program mode (or both).

Determine the storage estimates for NCP 2 operating exclusively in *network control mode* by adding together the various estimates in Chapter 2.

Determine the storage estimates for NCP 2 operating exclusively in *emulation mode* by adding together the various estimates in Chapter 4.

Determine the storage estimates for NCP 2 operating in both emulation mode *and* network control mode (via the partitioned emulation programming extension) by adding together the various estimates in both Chapter 2 and Chapter 4.

Calculating Storage for NCP 5

The fifth version (NCP 5) allows the communications controller to operate in either emulation mode or network control mode, or both.

Determine the storage estimates for NCP 5 operating exclusively in *network control mode* by adding together the various estimates in Chapter 3.

Determine the storage estimates for NCP 5 operating exclusively in *emulation mode* by adding together the various estimates in Chapter 4.

Determine the storage estimates for NCP 5 operating the controller in both network control program mode *and* emulation mode by adding together the estimates for both program modes in Chapter 3 and Chapter 4.

Performance

Performance is one of the major factors on which the total productivity of a system depends. NCP performance is largely determined by your combinations of message rates, block size of the messages, line speeds, line discipline, interrupt priorities, generation options chosen, the type of applications and how they complete for the mechanical arms of the disp packs, the amount of buffer space available, and the type of scanner and channel adapter installed.

Chapter 5, "Planning for Performance for NCP," describes how various operands are closely associated with performance and provides advice for selecting appropriate parameters for those operands.

Chapter 2: NCP 1 and NCP 2 Storage Estimates

This chapter is designed to provide assistance in calculating storage estimates for either NCP 1 or NCP 2 (TYPGEN=NCP or PEP). In this chapter NCP 1 and NCP 2 are referred to as the network control program or NCP unless there is a difference in the estimates for the two versions, in which case they are distinguished in the text.

Note: If you have generated an NCP 2 using only lines operating in emulation mode (TYPGEN=EP), calculate the storage estimates by referring to Chapter 4 only.

The total storage estimate for the network control program is the sum of storage for the individual categories listed below:

- Base code
- User code
- Buffers
- Optional code
- Emulation program estimates (TYPGEN=PEP)

The network control program has many optional system functions and many optional line/device support capabilities. Many optional tables and variable length resource control blocks also require storage in the controller. All of these influence the total amount of controller storage required for the network control program. Select the options and other categories and place the appropriate storage estimate in the space provided. After determining the individual estimates, total them to get the overall estimated storage. This storage estimate (minus buffer requirements) can then be used to determine the auxiliary storage needed for the load module.

Base Code

If the storage size (MEMSIZE) being defined is less than or equal to 64K, enter 27,648 in the space provided. If MEMSIZE is greater than 64K, enter 28,426.

Enter the total: ______

User Code

This is the code for the block handling routines you write. Your code will be placed on a 2K (2048) boundary; therefore, you have a potential storage loss of (2K minus 1) bytes.

Enter the total of UBHR code + 2047: ______

Buffers

After the NCP is generated and loaded into the controller, the NCP determines the amount of storage left in the controller, and it uses that remaining space for buffers. For example, an 80K byte controller containing a 64K NCP will have 16K of buffer space built by the network control program.

Use the following procedure to determine if you have enough storage left to build the necessary buffers.

The estimate for buffers will tend to be high in most cases, especially as the number of attached lines increases.

Step 1: (Average block size for each line + 30)/(buffer size minus 4)= number of buffers needed for this line. Round the total upward to the next integer. (The buffer size should be the value specified in the BFRS operand on the BUILD macro rounded up to the next multiple of 4, plus 4.)

Step 2: (Number of buffers needed for this line x buffer size) = approximate bytes of buffer space needed for this line.

Repeat steps 1 and 2 until all lines are accounted for. Then, to estimate the total number of bytes of buffer storage required for your network, first add together the following:

Total for all lines (total the results of step 2 for all lines) ______

Size of one buffer (four, plus the value specified in BFRS operand of BUILD macro rounded up to the nearest multiple of four.) ______

Buffer storage required to contain the largest average block size in the network. (To calculate this figure, use the formulas in steps 1 and 2 above only once, using the largest block size.) ______

Total ______

After the NCP is loaded into the controller, any remaining storage is reserved as buffer space. However, a certain percentage of that buffer space, the percentage specified for the SLODOWN operand of the BUILD macro, is available only when the NCP is operating in slowdown mode. To assure that the NCP's responsiveness is not degraded when operating in slowdown mode, you should increase the amount of buffer storage. Calculate the total number of buffers needed (total buffer storage calculated above divided by buffer size). Multiply the result by (100 ÷ (100 - R)), where R is the slowdown percentage; then round the product up to the nearest integer and multiply by the buffer size.

Total buffer storage, including slowdown contingency: ______

Example:

Average block size for line 1 is 200
Average block size for line 2 is 80
Buffer size equals 64 (BFRS specified as 60)
SLODOWN is specified as 12

For line 1:

Step 1. (200 + 30)/(64 - 4) = 3.8 (round up to 4)
Step 2. (4 x 64) = 256 bytes of buffer space needed for this line.

For line 2:

Step 1. (80 + 30)/(64 - 4) = 1.8 (round up to 2)
Step 2. (2 x 64) = 128 bytes of buffer space needed for this line.

Total for lines 1 and 2:

(256 + 128) = 384 bytes

Storage needed for largest block size:

Largest average block size is 200 (for line 1)
(200 + 30)/(64 - 4) = 3.8 (round up to 4)
4 x 64 = 256 bytes

Total buffer storage required:

(384 + 64 + 256) = 704 bytes

Number of buffers required:

704/64 = 11 buffers

Number of buffers needed with SLODOWN specified as 12:

11 x (100/(100 - 12)) = 11 x 1.1363 = 12.5 (round up to 13)

Total buffer storage required with slowdown contingency:

13 x 64 = 832 bytes

Optional Code

This portion of code consists of the following categories:

- Optional system functions
- Optional line/device support
- Optional tables
- Resource control blocks

Optional System Functions

This category is composed of:

- Control command support (dynamic control facilities)
- Block-handling options
- Panel test
- Address trace
- Line trace
- Critical situation notification
- Online test
- Checkpoint/restart
- Auto-network shutdown
- Supervisor abend facility
- Time sharing options
- Channel adapter optional features

The total storage estimate for this category is the total, in bytes, for all optional system functions included in your program.

For each function that you have included, enter the indicated amount in the space provided. The total for this category is the sum of the individual estimates.

Control Command Support

See Figure 2-1 to determine storage estimates for control command support.

Deactivate Line Halt		*		*				*		*	*	*						*					
Deactivate Line Orderly	*	*					*	*		*	*	*	*					*					*
Switch to Backup			*		*							*		*				*					
Reset Immediate		*				*				*	*				*	*	*				*		*
Reset Conditional		*				*			*	*	*				*	*	*				*	*	*
Reset-End of Command or Reset Device Queue		*				*				*	*				*	*	*				*		*
Change Session Limit																			*	*			
Change Service Seeking Pause																			*	*			
Change Negative Poll Limit																			*	*			
Copy/Replace Destination Mode																				*			
Change Device Transmission Limit																				*			
Modify BH Set Association																				*			
Set Date and Time																				*			
Byte Count	670	601	1050	318	764	479	190	198	190	146	114	146	114	192	96	126	78	78	78	52	62	93	51
Insert ✓ in any column containing an asterisk if it is adjacent to a command you employ																							
TOTAL																							

Figure 2-1. Control Command Storage Matrix for OS and OS/VS TCAM Users

To use Figure 2-1, select the commands used in your network control program. For example, *Change Session Limit* has an asterisk in two boxes. Place a check mark in the box at the bottom of each column with an asterisk. (There should be a check mark below 78 and 52.) Now select another command, for example, *Set Date and Time*. This command has an asterisk in only one box, which is above a byte count of 52. However, it is the same 52 bytes that *Change Session Limit* caused to be checked. Ignore this command and proceed to the next command.

After placing check marks in the appropriate boxes, write the byte count into the box below the checked column and add the numbers.

Enter total from Figure 2-1 here: ______

Additionally, if your program has any of the following commands, enter the appropriate amount in the space provided.

Display line status (LNSTAT):	62	______	
Change speed (SPDSEL) (NCP 2 only):	240	______	
Change device transmission limit (XMTLMT):	78	______	
Copy/replace destination mode flags (MODE):	164	______	
Change BH set association (BHSASSC):	182	______	
Display device status (DVSTAT):	122	______	
Request device statistics (RDVSTAT):	96	______	
Set date/time (DATIME):	248	______	
Display storage (STORDSP):	198	______	
Activate invites (ACTI):	36	______	
Copy/replace line session initiation information (SESINIT):	1,458	______	
Copy/replace device session initiation information (DVSINIT):	398	______	
If SESINIT or DVSINIT and BSC lines:	480	______	
If no BHRs:	226	______	
If no BHRs, and ABEND=YES:	82	______	
Total control command support:			______

Block Handling Routine (BHR) Support

If your NCP has any of the following, enter the appropriate amount in the space provided.

BHR base support:	1,476	______	
ABEND=YES (BUILD macro):	184	______	
Backspace edit (EDIT macro):	258	______	
Date/time insertion (DATETIME macro):	584	______	
Number of BHSET macros times 18:		______	
Number of EDIT macros times 14:		______	
Number of DATETIME macros times 10:		______	
Number of UBHR macros times 10:		______	
Total BHR support			______

Select the following applicable support functions and place the appropriate figure in the space provided.

Panel Test (BUILD Macro)

Panel test (PNLTEST) (NCP 2 only)

Type 1 scanner:	1,408	______
Type 2 scanner:	1,378	______

Address Trace (BUILD Macro)

Address trace (TRACE):	378	______

Line Trace (BUILD Macro)

Line trace (LTRACE): (includes trace table)	752	______

Critical Situation Notification (BUILD Macro)

For critical situation notification, enter 202 plus the number of characters in the critical situation message and header (CRITSIT, CSMSG, CSMSGC, CSMHDR): ______

Online Test (BUILD Macro)

For online test (OLT) for a controller:

Less than 64K:	3,024	______	
Greater than 64K:	3,264	______	
No control reset or deactivate commands selected:	52	______	
Total for online test:			______

Checkpoint Restart (BUILD Macro)

Checkpoint/restart (CHKPT):	762	______

Auto-Network Shutdown (BUILD Macro)

Auto-network shutdown (ANS):	602	______
No deactivate commands selected:	198	______

Supervisor Abend Facility

Supervisor abend facility (ABEND):	1,420	______

Time Sharing Option

Carriage delay and monitor:	900	______

Channel Adapter Optional Features Support (HOST Macro)

Type 1 channel adapter:		
Greater than 64K:	44	_____
Attention time-out (TIMEOUT):	88	_____
Attention delay (DELAY):	44	_____
Type 2 or 3 channel adapter optional features:		
Greater than 64K:	36	_____
Attention time-out (TIMEOUT):	126	_____
Attention delay (DELAY):	52	_____
Two loosely-coupled channels:	770	_____

Control Word (CW) area:
If *padding* (BFRPAD) is used in transfers to the host, CW area equals:
4A(B + 3)+4C _____

where
A = Host buffer units (MAXBFRU)
B = Host unit size (UNITSZ) divided by controller buffer size (BFRS), rounded down to the nearest whole number
C = Controller buffer allocation for input (INBFRS)

If *no padding* (BFRPAD) is used in transfers to the host, CW area equals:
4A(B + 2)+4C _____

Total channel support: _____

Total optional system functions: _____

Optional Line/Device Support

The options described in this section apply to:

- BSC line control
- Start-stop line control
- Type 1 communication scanner support
- Multipoint lines
- Point-to-point lines
- Switched lines
- Nonswitched lines
- Miscellaneous line/device support

Enter the appropriate amount in the space provided.

BSC Line Control (GROUP Macro)

Binary Synchronous (LNCTL=BSC):	2,928	_____
Point-to-point:	410	_____
Multipoint tributary (TADDR):	700	_____
Online test in system (OLT):	168	_____
Transparent ITB mode (XITB):	520	_____

BSC ASCII code (CODE=):	570	_____
Multipoint tributary (TADDR):	32	_____
Online test (OLT):	32	_____
Total BSC:		_____

Start-Stop Line Control (GROUP Macro)

Start-stop (LNCTL=SS):	1,782	_____
Point-to-point (POLLED=NO):	606	_____
Longitudinal redundancy checking (FEATURE=LRC):	146	_____
Multipoint (POLLED=YES):	128	_____
Total start-stop:		_____

Type 1 Communication Scanner Support (CSB macro)

Type 1 communication scanner (TYPE):	1,588	_____

Multipoint Lines (LINE Macro)

Multipoint lines (POLLED=YES):	1,566	_____
Type 1 communication scanner:	678	_____
Type 2 communication scanner:	678	_____
Total multipoint:		_____

Point-to-Point Lines (LINE Macro)

Switched (DIAL=YES):	88	_____
Nonswitched (DIAL=NO):	68	_____
Total point-to-point:		_____

Switched Lines (GROUP Macro)

Switched lines (DIAL=YES)		
NCP 1:	1,406	_____
NCP 2 (includes manual dial):	1,742	_____
CALL=INOUT or CALL=OUT:	1,728	_____
Ring indicator mode (LINE/RING):	38	_____
IDLIST macro		
If IDSEQ=(chars), add 800 bytes:		_____
If IDSEQ=(chars, term name) add 1,110 bytes:		_____
Multiple Terminal Access (TERMINAL/TERM=MTA)		
MTA-call out:	42	_____
If MTA-call out only (no call in):	146	_____
MTA-call in:	1,654	_____

MTA and block handler support (BHSET on TERM, COMP, or CLUSTER macro):	52	_____
Total switched lines:		_____

Nonswitched Lines (GROUP Macro)

Nonswitched lines (DIAL=NO):	182	_____

Miscellaneous Line/Device Support

General poll (excluding 2972 with batch message input feature) (GPOLL=chars):	1,864	_____
2972 terminals (without batch message input feature):	56	_____
3270 or 3740 terminals (NCP 2):	460	_____
3270 terminals only:	134	_____
2740-II terminals:	224	_____
83B3 or 115A terminals:	710	_____
TWX terminals:	472	_____
WTTY terminals:	676	_____
Both TWX and WTTY terminals:	138	_____
Buffered receive feature (BFRDLAY):	162	_____
ENDTRNS=EOB:	52	_____
Total miscellaneous line/device support:		_____
Total optional line/device support		_____

Tables

If your NCP uses any of the following tables generated by the FEATURE operand, the CODE operand, or the TADDR operand, enter the appropriate amount in the space provided. Usage is determined by whether code translation or command decoding is necessary.

For translate tables (CODE operand on the LINE macro), enter the amount from Figure 2-2: ______

S-S	BSC	Table	Bytes	
•		1050 with KATAKANA	564	______
•		1050/2740/2741 BCD[1]	564	______
•		1050/2740/2741 EBCD	564	______
•		2740/2741 Correspondence	564	______
•		WTTY with ITA2	564	______
•		WTTY with ZSC3	564	______
•		TWX	564	______
•		83B3/115A	564	______
	•	EBCDIC	142	______
	•	ASCII	564	______
			total	______

[1]BCD is required if call-in MTA is used in your system, even if none of your terminals require BCD.

Figure 2-2. Translate Decode Table for OS and OS/VS TCAM Users

For state address tables (FEATURE operand on TERMINAL macro), enter the amount from Figure 2-3: ______

S-S	BSC	Table	Bytes	
•		S-S (but not 2740-I) with checking	72	______
•		S-S (but not 2740-I) without checking	72	______
•		2740-II with checking	72	______
•		2740-II without checking	72	______
•		WTTY	72	______
•		TWX	72	______
•		115A/83B3	72	______
	•	EBCDIC	72	______
	•	ASCII	72	______
			total	______

Figure 2-3. State Address Table for OS and OS/VS TCAM Users

For command decode tables, enter the amount from Figure 2-4: ______

S-S	BSC	Table	Bytes	
•		2741 terminal	18	______
•		2740-II with checking	18	______
•		Multipoint 2740-I without checking, or 2740-I with station control and without checking	18	______
•		2740-I with transmit control	18	______
•		2740-I with transmit control and checking	18	______
•		2740-I contention with checking	18	______
•		TWX 33/35	18	______
•		WTTY	18	______
•		2740-I basic	18	______
•		2740-I multipoint	18	______
•		Multipoint 83B3/115A	18	______
	•	Point-to-point contention	18	______
	•	Multipoint control station	18	______
	•	Multipoint tributary	18	______
			total	______

Figure 2-4. Command Decode Table for OS and OS/VS TCAM Users

For MTA tables, calculate storage for the following macros:

MTALCST - 100 bytes for the first macro, plus ______
- 18 bytes for each additional macro ______
MTALIST - 1 byte per specified terminal type ______
MTAPOLL - 2 bytes per set of polling characters ______
MTATABL - 22 bytes per macro ______

Total for MTA tables: ______

For line types (one or both if applicable):

Switched lines: 450 ______
Nonswitched lines: 330 ______

Total line types: ______

For each group of switched dial-out lines (LINE/DIALSET):

18 + 4 times the number of line entries + 4 (if DIALALT is specified) + 4 (if the preceding DIALSET specified this DIALSET as its DIALALT). ______

Total for switched dial-out lines: ______

For each IDLIST macro enter:
Number of ID characters ______ + 6: ______
If device association, add 2 per entry: ______
If IDSEQ is required, add the number of bytes for CUID and TWXID characters: ______

Total for IDLIST: ______

For address trace tables (BUILD/TRACE):
Number of units ______ x 18 = ______ + 34 = ______

For control command lookup tables:
Number of optional Control commands ____ x 4= ______
(from "Control Command Support" above)

For online test (BUILD/OLT):

Switched lines:	52	______
Nonswitched lines:	32	______
Total online test:		______

If TYPE=TYPE1 (CSB macro), calculate (highest line address, in decimal, + 1) x 16: ______

If TYPE=TYPE2, select the number of CSB macros coded and enter the appropriate figure:

1 CSB macro	192 bytes	______
2 CSB macros	512 bytes	______
3 CSB macros	768 bytes	______
4 CSB macros	1,024 bytes	______

Total for CSB macros: ______

Total for tables: ______

Resource Control Blocks

This category of optional code is composed of:

- Logical line groups (LINELIST)
- Physical line groups (GROUP)
- Lines (LINE)
- Terminals (TERMINAL, COMP, CLUSTER)

The total storage requirement for this category is the total, in bytes, for all resource control blocks included in your program.

Logical Line Groups

Calculate the following for each LINELIST macro:
14 + (number of lines indicated x 4): ______

Total logical line groups: ______

Physical Line Groups

Calculate the following for each physical line group:

Multiply the number of 83B3/115A groups by 41; add 4 bytes if a type 1 scanner is installed in your controller and enter the total: ______

Multiply the number of WTTY groups by 45; add 4 bytes for a type 1 scanner:

Multiply the number of start-stop and BSC groups by 58 for type 2 scanners or by 62 for type 1 scanners: ______

Total physical line groups: ______

Lines

Calculate the following for lines:

Multiply the number of point-to-point nonswitched lines by 182 (DIAL=NO, POLLED=NO): ______

Multiply the number of multipoint lines by 214 (DIAL=NO, POLLED=YES): ______

For each switched line, add 186 (+ 4 bytes if the line is designated CALL=IN or CALL=INOUT). Add the per line requirements together and enter the total: ______

Total lines: ______

Stations

For each TERMINAL, COMP, or CLUSTER macro, enter 60 bytes plus the following amounts as applicable: ______

If DIRECTN=IN or INOUT:	12	______
If switched-backup line exists:	4	______
If CTERM=YES:	4	______
If IDSEQ is not equal to NONE:	4	______
If switched dial-out terminal, add the number of dial digits:	7	______
If BHEXEC=PT3 (TERMINAL macro):	22	______
If GPOLL=chars (CLUSTER macro):	18	______
If the station is on a multipoint line:	10	______
Add the number of polling characters and the number of addressing characters:		______

Total for all stations: ______

Total for Resource Control Blocks: ______

Total NCP 1 or NCP 2 Storage Estimates for NCP mode

Add the numbers in the extreme right hand column to arrive at the total network control program storage estimates. If you are operating under NCP 1 or in network control mode only (TYPGEN=NCP) under NCP 2, this is your total estimated storage. If you are operating in a partitioned emulation programming extension environment (TYPGEN=PEP), place the subtotal for NCP lines here, and carry it forward to add to the subtotal in Chapter 4 for the emulation lines to arrive at a total NCP mode and emulation mode storage estimate.

Subtotal network control program storage estimate: ______

Chapter 3: NCP 5 Storage Estimates

This chapter is structured to aid in calculating storage estimates for the network control program version 5 (NCP 5) for OS/VS and DOS/VS VTAM users operating in network control mode (TYPGEN=NCP) or both network control mode and emulation mode (TYPGEN=PEP).

Note: If you have generated an NCP 5 using only lines operating in emulation mode (TYPGEN=EP), calculate the storage estimates by referring to Chapter 4 only.

The total storage estimate for the network control program is the sum of storage for the individual categories listed below:

- Base code
- User code
- Buffers
- Optional code
- Emulation program estimates (TYPGEN=PEP)

The network control program has many optional system functions and many optional line/device support capabilities. There are also many optional tables and variable length resource control blocks that require storage in the controller. All of these influence the total amount of controller storage required for your network control program. Select the options and other categories and place the appropriate storage requirement in the space provided. After determining the individual estimates, total them to get the overall estimated storage. This storage requirement (minus buffer requirements) can then be used to determine the auxiliary storage needed for the OS/VS load module or the DOS/VS phase.

Base Code

Determine the total estimates for base code from Figure 3-1 by selecting the basic components that make up your system. For example, a network consisting of a local controller with BSC or start-stop lines, a type 3 communication scanner base, synchronous data link control (SDLC) links, and IBM 3600 SDLC terminals with a type 2 channel adapter and without auto network shutdown would require:

- Base code of 26,477
- BSC or start-stop code of 6,628
- SDLC line support code of 8,647
- SDLC terminal support code of 4,877
- Type 2 channel adapter code of 2,284

for a total base code estimate of 48,913

Enter the total from Figure 3-1 here: ______

	*Without Auto Network Shutdown**	*With Auto Network Shutdown**	
Base code - local controller			
Type 2 communication scanner only	26,477	27,006	______
Types 2 and 3 scanners	29,612	30,141	______
Type 3 scanner only	28,718	29,247	______
BSC/SS lines attached			
Type 2 scanner only	9,652	11,586	______
Types 2 and 3 scanners	12,406	14,340	______
Type 3 scanner only	6,628	8,562	______
SDLC lines attached			
Type 2 scanner only	7,719	8,577	______
Types 2 and 3 scanners	8,647	9,505	______
Type 3 scanner only	7,103	7,961	______
Remote controller attached ***	448	448	______
Backup SDLC local/remote link	240	240	______
Type 1 or type 4 channel adapter **	2,440	2,440	______
Type 2 or 3 channel adapter **	2,284	2,284	______
Base code - remote controller			
BSC/SS lines attached	9,652	11,586	______
SLDC lines attached	2,329	3,187	______
Multiple links to local controller	0	359	______
Activity timeout	143	143	______
SDLC terminals	4,877	4,877	______
Type 2 physical unit (3600, 3614 3650, 3660, 3770, 3790)	0	0	
Type 1 physical unit (3767, 3270)	536	536	______
3270 SDLC	1,286	1,286	______
SDLC dial lines	2,629	2,703	
Storage size (MEMSIZE) greater than 64K	600	600	______
Both BSC and SS lines included	207	207	______
Both SDLC and boundary node included	317	317	______
Total base code requirement:			______

Note: Add in second-level (indented) items only if first-level item applies.

Figure 3-1. Base Code Estimates for OS/VS and DOS/VS VTAM Users (Part 1 of 2).

* Auto network shutdown is an option (ANS) on the BUILD macro. It includes the configuration restart facility.

** If your 3705 has both type 1 or type 4 and type 2 or 3 channel adapters, include the base code figure for the type specified in the first suboperand of the CHANTYP operand on the BUILD macro.

***Must also include "SDLC lines attached."

Figure 3-1. Base Code Estimates for OS/VS and DOS/VS VTAM Users (Part 2 of 2).

User Code

This is the BHR code you generate. Your code will be placed on a 2K boundary; therefore, you have a potential storage loss of (2K minus 1) bytes.

Enter the total of user BHR code + 2047: ______

Buffers

After the NCP is generated and loaded into the controller, the NCP determines the total amount of available storage in the controller (as the smaller of either the user-specified storage size (MEMSIZE= operand of the BUILD macro)) or the physically installed storage. It then determines the storage already used, computes the amount of storage left in the controller, and uses that remaining space for buffers. For example, an 80K byte controller containing a 64K NCP will have 16K of buffer space built by the network control program.

Use the following formulas to determine if you have enough storage left to build the necessary buffers. The final result of these formulas indicates the amount of buffer storage you will need to handle your network's requirements 95% of the time.

The estimate for buffers will tend to be high in most cases, especially as the number of attached lines increases.

Calculating Buffer Storage Estimates for Start-Stop and BSC Lines

Step 1: Buffers per block = (average block size for each line + 30)/(buffer size - 4). Round the total up to the next integer. (The buffer size should be the value specified in the BFRs operand on the BUILD macro rounded up to the nearest multiple of 4, plus 4.)

Step 2: Calculate the number of buffers per line, *N*, as follows:

For start-stop and BSC point-to-point lines,

N = result of step 1.

For start-stop and BSC multipoint lines,

N = (result of step 1 x number of terminals on the line).

Step 3: (N x buffer size) = approximate number of bytes of buffer storage needed for this line.

Repeat steps 1, 2, and 3 until all start-stop and BSC lines are accounted for. Enter the total below.

Calculating Buffer Storage Estimates for SDLC Lines

The procedure for calculating buffer storage estimates for SDLC lines (other than the communication link between a local and a remote communications controller)

is found in Appendix B. If your NCP supports SDLC lines, turn to that appendix to perform your calculations, then enter the total below.

Calculating Buffer Storage Estimates for Local/Remote Communication Links

The procedure for calculating the buffer storage estimates for local/remote communication links is found in Appendix C. If your NCP supports a local/remote communication link, turn to that appendix to perform your calculations, then enter the total below.

Calculating Total Buffer Storage Estimates

To get the total number of bytes of buffer storage required for your network, first add together the following:

Total for all start-stop and BSC lines	______
Total for all SDLC lines	______
Total for all local/remote communication links	______
Size of one buffer (value specified in BFRS operand of BUILD macro)	______
Buffer storage required to contain the largest average block size in the network. (Average block size + 30)/(buffer size - 4); round up to next integer and multiply by buffer size	______
Total	______

After the NCP is loaded into the controller, any remaining storage is reserved as buffer space. However, a certain percentage of that buffer space, the percentage specified for the SLODOWN operand of the BUILD macro, is available only when the NCP is operating in slowdown mode. To assure that the NCP's responsiveness is not degraded when operating in slowdown mode, you should increase the amount of buffer storage. Calculate the total number of buffers needed (total buffer storage calculated above divided by buffer size). Multiply the result by (100/(100 - R)), where R is the slowdown percentage; then round the product up to the nearest integer and multiply by the buffer size.

If you are calculating the estimates for a remote communications controller, you must allow at least enough storage for the load program to be loaded into the controller. (This space is used for buffers after the NCP is loaded.) In this case, use whichever value is larger: (1) the result of your buffer storage calculations, or (2) the amount of storage needed for the load program (5,756 bytes with a type 1 communication scanner; 4,268 bytes with a type 2 communication scanner).

Total buffer storage, including slowdown contingency: ______

Example of Calculating Buffer Storage Estimates

Calculate the amount of buffer storage needed for the following network. The buffer size is 64 (BFRS specified as 60) and SLODOWN is specified as 12.

Line 1 Start-stop, point-to-point line with average block size of 200.
Line 2 Start-stop, multipoint line with 10 terminals and average block size of 80.
Line 3 4800 bps, half-duplex, multipoint SDLC line

Interactive portion of line load:
1 cluster node with 3 logical units (75% of traffic)
1 terminal node (25% of traffic)

Batch portion of line load:
2 cluster nodes with 4 logical units each (80% of traffic)
1 terminal node (20% of traffic)

Line 4 7200 bps, half-duplex, SDLC local/remote communication link

For line 1:

Step 1. (200 + 30)/(64 - 4) = 3.8 (round up to 4)
Step 2. N = 4
Step 3. (4 x 64) = 256 bytes of buffer storage

For line 2:

Step 1. (80 + 30)/(64 - 4) = 1.8 (round up to 2)
Step 2. N = (2 x 10) = 20
Step 3. (20 x 64) = 1280 bytes of buffer storage

For line 3:

See Appendix B for example of calculations.

For line 4:

See Appendix C for example of calculations.

Total for lines 1, 2, 3, and 4:

Assume all lines are attached to the local communications controller.
256 + 1280 + 13,376 + 1920 = 16,832 bytes

Storage needed for largest block size:

Largest average block size is 400 (for batch portion of line 3)
(400 + 23)/(64 - 4) = 7.05 (round up to 8)
8 x 64 = 512 bytes

Total buffer storage required:

16,832 + 64 + 512 = 17,408 bytes

Number of buffers required:

17,408/64 = 272 buffers

Number of buffers needed with SLODOWN specified as 12:

272 x (100/(100 - 12)) = 272 x 1.1363 = 309.1 (round up to 310)

Total buffer storage required with slowdown contingency:

310 x 64 = 19,840 bytes

Optional Code

This portion of code consists of the following categories:

- Optional system functions
- Optional line/device support
- Optional tables
- Resource control blocks

Optional System Functions

This category is composed of:

- Control command support (dynamic control facilities)
- Block-handling options (local controller)
- Address trace
- Critical situation notification
- Online test
- Supervisor abend facility
- Time sharing options
- BSC/SDLC path function
- Channel support

The total storage requirement for this category is the total, in bytes, for all optional system functions included in your program.

Select each function that you have included and enter the indicated amount in the space provided. The total for this category is the sum of the individual estimates.

Control Command Support (SYSCNTRL Macro)

See Figure 3-2 to determine storage estimates for SS/BSC device control command support.

Reset Immediate (RIMM) TCAM/VTAM	*					
Reset Conditional (RCOND) TCAM/VTAM	*	*				
Reset at End of Command (RECMD) VTAM	*					
Change Session Limit (SESSION) VTAM			*	*		
Change Service-Seeking Pause (SSPAUSE) VTAM			*	*		
Change Negative Poll Limit (NAKLIM) VTAM			*	*		
Set Destination Mode (MODE) TCAM/VTAM				*	*	
Change Device Transmission Limit (XMTLMT) TCAM				*		*
Insert ✓ in any column containing an asterisk if it is adjacent to a command you employ						
TOTAL	1843	236	78	52	164	120

Figure 3-2. Control Command Storage Matrix for OS/VS and DOS/VS VTAM Users

To use Figure 3-2, select the commands used in your network control program. For example, *Change Session Limit* has an asterisk in two boxes. Place a check mark in the box at the bottom of each asterisk column. (There should be a check mark above 78 and 52.) Now select another command, for example, *Change Negative Poll Limit.* This command has an asterisk in the same columns as *Change Session Limit.* Ignore this command and proceed to the next command.

After placing check marks in the appropriate boxes, write the byte count into the box below the checked column and add the numbers.

Enter total from Figure 3-2 here: ______

Additionally, if your network control program includes any of the following options, enter the appropriate amount in the space provided.

Display line status (LNSTAT):	62	______
Change speed (SPDSEL):	240	______
Physical disconnect (ENDCALL):	76	______
Change BH set association (BHSASSC):	182	______
Replace line session initiation information (SESINIT):	1,428	______
Replace device session initiation information (DVSINIT):	398	______
If SESINIT or DVSINIT and BSC lines, add:	480	______
If no BHRs, add:	126	______
If no BHRs, and ABEND=YES, add:	82	______
Switched network backup (BACKUP):	2,592	______

Total control command support: ______

Block Handling Routine (BHR) Support (SS/BSC only)

If your NCP has any of the following, enter the appropriate amount in the space provided.

BHR base support:	1,320	______
ABEND=YES (BUILD macro):	128	______
Backspace edit (EDIT macro):	258	______
Date/time insertion (DATETIME macro):	554	______
Number of BHSET macros times 18:		______
Number of EDIT macros times 14:		______
Number of DATETIME macros times 10:		______
Number of UBHR macros times 10:		______

Total BHR support: ______

Select the following applicable support functions and place the appropriate figure in the space provided.

Address Trace (BUILD Macro)

Address trace (TRACE): 378 ______

Critical Situation Notification (BUILD Macro)

For critical situation notification, enter 272 plus the number of characters in the critical situation message

and header (CRITSIT, CSMSG, CSMSGC, CSMHDR):		______

Online Test (BUILD Macro)

For online test (OLT) for a system:		
SDLC only		
Type 2 communication scanner only	5,121	______
Types 2 and 3 scanners	6,078	______
Type 3 scanner only	5,641	______
BSC or SS with or without SDLC		
Type 2 communication scanner only	8,072	______
Types 2 and 3 scanners	9,029	______
Type 3 scanner only	8,592	______
With auto network shutdown	462	______
Total for online test:		______

Supervisor Abend Facility (BUILD Macro)

Supervisor abend facility (ABEND):	1,020	______

Time Sharing Option for start-stop (LINE Macro)

Carriage delay and monitor:	1,190	______

BSC/SDLC Path Function (LU Macro)

BSC/SDLC path support:	4,140	______

Channel Adapter Optional Features Support (HOST Macro)

Channel adapter optional features support:		
Type 1 channel adapter:		
Greater than 64K:	42	______
Attention time-out (TIMEOUT):	26	______
Attention delay (DELAY):	68	______
Status modifier (STATMOD):	60	______
Erase (BUILD/ERASE):	60	______
PEP extension:	126	______
CA trace - 34 bytes per entry, plus 142:		______
Type 2 or 3 channel adapter optional features:		
Greater than 64K:	36	______
Attention time-out (TIMEOUT):	126	______
Status modifier (STATMOD):	24	______
Erase (BUILD/ERASE):	68	______
Attention delay (DELAY):	68	______
CA trace - 34 bytes per entry, plus 142:		______

Control Word (CW) area:
If *padding* (BFRPAD) is
used in transfers to the host,

CW area equals:
4A(B + 3)+4C ______

where
A = Host buffer units (MAXBFRU)
B = Host unit size (UNITSZ) divided by controller buffer size (BFRS) rounded down to the nearest whole number
C = Controller buffer allocation for input (INBFRS)

If *no padding* (BFRPAD) is used in transfers to the host,
CW area equals:
4A(B + 2)+4C ______

Total channel adapter optional features: ______

Total optional system functions: ______

Optional Line/Device Support

The options described in this section apply to:

- BSC line control
- Start-stop line control
- Type 1 communication scanner support
- Multipoint lines
- Point-to-point lines
- Switched lines
- Local/remote link
- Nonswitched lines
- Miscellaneous line/device support

If your system has any of the following support, enter the appropriate amount, in the space provided.

BSC Line Control (GROUP Macro)

Binary synchronous (LNCTL=BSC):	2,928	______	
Point-to-point (POLLED=NO):	410	______	
Multipoint tributary (TADDR):	700	______	
Online test in system (OLT):	216	______	
Transparent ITB mode (XITB):	520	______	
BSC ASCII code (CODE):	570	______	
Multipoint tributary (TADDR):	32	______	
Online test (OLT):	32	______	
Total BSC:			______

Start-Stop Line Control (GROUP Macro)

Start-stop (LNCTL=SS)	2,160	______
Point-to-point (POLLED=NO):	782	______
Longitudinal redundancy checking (FEATURE=LRC):	76	______
Multipoint (POLLED=YES):	128	______

Total Start-Stop:		______

Type 1 Communication Scanner Support (CSB Macro)

Character service with type 1 scanner:	278	______	
Bit service (SDLC only):	1,304	______	
Bit service (BSC, S-S, DIAL, SDLC):	1,904	______	
Bit service (BSC, S-S, DIAL only):	1,256	______	
Bit service table (with SDLC):	256	______	
Bit service table (without SDLC):	128	______	
Total CSB macro:			______

BSC and Start-Stop Multipoint Lines (LINE Macro)

Multipoint lines:	1,420	______	
Type 1 communication scanner:	678	______	
Type 2 communication scanner:	678	______	
Total multipoint:			______

BSC and Start-Stop Point-to-Point Lines (LINE Macro)

Switched (DIAL=YES):	88	______	
Nonswitched (DIAL=NO):	68	______	
Total point-to-point:			______

BSC and Start-Stop Switched Lines (GROUP Macro)

Switched lines (includes manual dial):			
Type 2 communication scanner only	1,540	______	
Types 2 and 3 scanners	1,699	______	
Type 3 scanner only	1,621	______	
CALL=INOUT or CALL=OUT:	1,560	______	
Ring indicator mode (LINE/RING):	38	______	
IDLIST macro			
If IDSEQ=(chars):	800	______	
If IDSEQ=(chars, term name):	1,110	______	
Multiple Terminal Access (TERMINAL/TERM=MTA)			
MTA-call out: (LINE/CALL=)	42	______	
If MTA-call out only (no call in):	146	______	
MTA-call in:	1,540	______	
MTA and block handler support (BHSET on TERM, COMP, or CLUSTER macro):	52	______	
Total switched lines:			______

Nonswitched Lines (GROUP Macro)

Nonswitched lines:	182	______

Miscellaneous Line/Device Support

General poll (excluding 2972 with batch message input feature) (GPOLL=chars):	1,530	______
2972 terminals (without batch message input feature):	56	______
Both 3270 and 3740 BSC terminals:	460	______
3270 BSC terminals only:	134	______
2740-II terminals:	224	______
83B3 or 115A terminals:	600	______
TWX terminals:	472	______
WTTY terminals:	676	______
Both TWX and WTTY terminals:	138	______
Buffered receive feature (BFRDLAY):	162	______
ENDTRNS=EOB (TERMINAL or COMP):	52	______
2741/1050 break feature:	110	______

Total miscellaneous line/device support: ______

Total optional line/device support: ______

Tables

If your NCP uses any of the following tables generated by the FEATURE operand, the CODE operand, or the TADDR operand, enter the appropriate amount in the space provided. Usage is determined by whether or not code translation or command decoding is necessary.

For Translate Tables (CODE operand on the LINE macro), enter the amount from Figure 3-3: ______

S-S	BSC	Table	Bytes	
•		1050 with KATAKANA	564	______
•		1050/2740/2741 BCD[1] (Normal)	564	______
	•	1050/2740/2741 BCD (Modified)	564	______
•		1050/2740/2741 EBCD	564	______
•		2740/41 Correspondence (Normal)	564	______
	•	2740/41 Correspondence (Modified)	565	______
•		WTTY with ITA2	564	______
•		WTTY with ZSC3	564	______
•		TWX (Normal)	564	______
	•	TWX (Modified)	282	______
•		83B3/115A	564	______
	•	EBCDIC	142	______
	•	ASCII	564	______
			total	______

[1]BCD is required if call-in MTA is used in your system, even if none of your terminals require BCD.

Figure 3-3. Translate Decode Table for OS/VS and DOS/VS VTAM Users

For state address tables (FEATURE operand on TERMINAL macro), enter the amount from Figure 3-4: ______

S-S	BSC	SDLC	Table	Bytes	
•			S-S (but not 2740-I) with checking	72	______
•			S-S (but not 2740-I) without checking	72	______
•			2740-I with checking	72	______
•			2740-I without checking	72	______
•			WTTY	72	______
•			TWX	72	______
•			83B3/115A	72	______
	•		EBCDIC	72	______
	•		ASCII	72	______
		•	Primary station	18	______
		•	Secondary station (remote)	18	______
				total	______

Figure 3-4. State Address Table for OS/VS and DOS/VS VTAM Users

For command decode tables, enter the amount from Figure 3-5: ______

S-S	BSC	Table		
•		2741 terminal	18	______
•		2740-II with checking	18	______
•		Multipoint 2740-II without checking, or 2740-I with station control and without checking	18	______
•		2740-I with transmit control	18	______
•		2740-I with transmit control and checking	18	______
•		2740-I contention with checking	18	______
•		TWX 33/35	18	______
•		WTTY	18	______
•		2740-I basic	18	______
•		2740-I multipoint	18	______
•		Multipoint 83B3/115A	18	______
	•	Point-to-point contention (BSC or S-S)	18	______
	•	Multipoint control station (BSC or S-S)	18	______
	•	Multipoint tributary (BSC or S-S)	18	______
			total	______

Figure 3-5. Command Decode Table for OS/VS and DOS/VS VTAM Users

For MTA tables, calculate for the following macros:

MTALCST - 100 bytes for the first macro, plus ______
- 18 bytes for each additional macro ______
MTALIST - 1 byte per specified terminal type ______
MTAPOLL - 2 bytes per set of polling characters ______
MTATABL - 22 bytes per macro ______

Total for MTA Tables: ______

For line types (one or both if applicable):

Switched lines: 450 ______
Nonswitched lines: 330 ______

Total line types: ______

For each group of switched dial-out lines (DIALSET):

18 + 4 (number of line entries) + 4 (if DIALALT is specified) + 4 (if the preceding DIALSET specified this DIALSET as its DIALALT). ______

Total for dial sets: ______

For each IDLIST macro enter,

Number of ID characters ______ + 6: ______
If device association, add 2 per entry: ______
If IDSEQ is required, add the number of bytes for CUID and TWXID characters: ______

Total for IDLIST: ______

For address trace tables (TRACE):
Number of units ______ x 18 = ______ + 34 = ______

For control command lookup tables:
Number of optional Control commands ____ x 4= ______
(from "Control Command Support" above)

For online test (OLT):

Switched lines:	52	______
Nonswitched lines:	32	______

Total online test: ______

If TYPE=TYPE1 (CSB macro), calculate (highest line address, in decimal, + 1) x 16: ______

If TYPE=TYPE2, select the number of CSB macros coded and enter the appropriate figure:

1 CSB macro	192 bytes	______
2 CSB macros	512 bytes	______
3 CSB macros	768 bytes	______
4 CSB macros	1,024 bytes	______

Total for CSB macro: ______

Total for optional tables: ______

Resource Control Blocks

This category of optional code is composed of:

- Logical line groups (LINELIST Macro)
- Physical line groups (GROUP Macro)
- Lines (LINE Macro)
- Stations (TERMINAL, COMP, CLUSTER Macros)

The total storage estimate for this category is the total, in bytes, for all resource control blocks included in your program.

Logical Line Groups (LINELIST Macro)

Calculate the following for each LINELIST macro:
14 + (number of lines indicated x 4): ______

Total logical line groups: ______

Physical Line Groups (GROUP Macro)

Calculate the following for each physical line group:
(Number of 83B3/115A groups x 41) + 4 bytes for a type 1 scanner and enter the total: ______

(Number of WTTY groups x 45) + 4 bytes for a type 1 scanner: ______

Number of start-stop and BSC groups x 58 (for type 2 scanners) or 62 (for type 1 scanners): ______

Total physical line groups: ______

Lines (LINE Macro)

Multiply the number of point-to-point BSC or S/S nonswitched lines by 182 (DIAL=NO, POLLED=NO) ______

Multiply the number of point-to-point BSC nonswitched lines used for the BSC/SDLC path function by 186 (DIAL=NO, POLLED=NO, BSC/SDLC path conversion BHR associated with the terminal) ______

Multiply the number of multipoint BSC or S-S lines by 214 (DIAL=NO, POLLED=YES) ______

For each switched BSC or S-S line, add 186 (+ 4 bytes if the line is designated CALL=IN or CALL=INOUT). Add the per line estimates together and enter the total: ______

Half duplex SDLC line, 158 for each line, plus 16 bytes if using a type 1 scanner: ______
Duplex SDLC line, 260 for each line, plus 32 bytes if using a type 1 scanner: ______

Total lines: ______

Stations (TERMINAL, COMP, CLUSTER, LU, PU, INNODE, LUPOOL Macros)

SDLC Stations:
- For PU type 1 (PU macro) or PU type 2 (PU or CLUSTER macro):
  - On nonswitched lines, multiply the number of PU or CLUSTER macros times 101 bytes: ______
  - On switched lines, multiply the number of PU or CLUSTER macros times 106 bytes: ______
  - On switched lines, add for each PU or CLUSTER macro, 4 times the value specified on the MAXLU operand: ______
- For LU macros:
  - Associated with PU type 1, multiply the number of LU macros times 75 bytes: ______
  - Associated with PU type 2 (PU or CLUSTER macro), multiply the number of PU or CLUSTER macros times 59 bytes: ______
  - Associated with BSC/SDLC path function PU type 2 (PU or CLUSTER), multiply the number of PU or CLUSTER macros times 79 bytes: ______
- For LUPOOL macro:
  - Multiply the number of logical units specified times 75 bytes: ______
- For PU type 4 (PU or INNODE macro):

Multiply the number of PU type 4 (PU or INNODE) macros times 79 bytes: ______

BSC/Start-Stop Stations:

For each TERMINAL, COMP, or CLUSTER macro, enter 60 bytes: ______

Plus the following amounts as applicable:

If DIRECTN=IN or INOUT:	12	______
If switched-backup line exists:	4	______
If switched CTERM=YES terminal:	4	______
If IDSEQ is not equal to NONE:	4	______
If switched dial-out terminal, add the number of dial digits:	7	______
If BHEXEC=PT3 (TERMINAL macro):	22	______
If GPOLL=chars (CLUSTER macro):	18	______
If the station is on a multipoint line:	10	______
add the number of polling characters and the number of addressing characters:		______

Total for all stations: ______

Total for Resource Control Blocks: ______

Total NCP 5 Storage Estimates for NCP Mode

Add the numbers in the extreme right-hand column to arrive at the total network control program storage estimates. If you are operating in network control mode only (TYPGEN=NCP) under NCP 5, this is your total estimated storage.

If you are operating in a partitioned emulation programming extension environment (TYPGEN=PEP) place the subtotal for NCP lines here, and carry it forward and add it to the subtotal for the emulation lines (Chapter 4) to arrive at a total network control mode and emulation mode storage estimate.

Subtotal network control program storage estimate: ______

Chapter 4: Emulation Mode Storage Estimates

This chapter describes the procedures for calculating NCP 2 or NCP 5 storage estimates when operating in emulation mode (TYPGEN=EP or PEP). This chapter also applies to the emulation program/VS, version 3 (EP/VS 3), which is equivalent to the program generated when TYPEGEN=EP is specified in an NCP generation. The amount of storage required depends on the configuration of the teleprocessing subsystem:

- The number and types of terminals
- The type of communication scanner used
- The type of communication line control used

Determine the total amount of storage for the emulation portion of NCP 2 or NCP 5, or for EP/VS 3, by adding the individual storage estimates for:

- Base code
- Code needed to support specific configurations and options
- Emulation program control blocks and tables

Emulation Base Code

	Type 1 CA	Type 4 CA	
Emulation base code (including code for the loader):	5,738	11,560	______

Type 1 Communication Scanner Support

Type 1 scanner support for (select one):

	Type 1 CA	Type 4 CA	
Binary synchronous lines only:	1,432	N/A	______
Start-stop lines only:	1,720	N/A	______
Binary synchronous and start-stop:	1,858	N/A	______

Total type 1 scanner support: ______

Note: There are no type 2 or type 3 scanner storage estimates similar to the type 1 scanner support.

Start-Stop Terminal Support

The following represents code required to support the operation of start-stop terminal types (choose the applicable option). For example, for a network consisting of IBM 2260 and 1050 terminals, select IBM type I, II and III for a total of 2,368 bytes.

	Type 1 CA	Type 4 CA	
IBM type I and II:	2,032	2,136	______
IBM type III:	2,128	2,176	______
IBM type I, II and III:	2,368	2,472	______
IBM and TTY type I and II:	2,632	2,736	______
TTY type I and II:	2,408	2,464	______
TTY I and II and IBM type III:	2,744	2,800	______
TTY I and II and IBM I, II and III:	2,968	3,072	______
If "DELAY", add:	88	88	______

Total start-stop terminal support: ______

IBM type I and II	- IBM 1030, 1050, 1060, 2740, 2741
IBM type III	- IBM 2260/2848, 2265/2845
TTY type I	- AT & T 83B2, 83B3, WU 115A line control
TTY type II	- TWX 33/35 line control

Binary Synchronous Terminal Support

The following represents code required to support synchronous line control (choose the applicable option):

	Type 1 CA	Type 4 CA	
Type 2 scanner only			
EBCDIC only:	2,672	3,664	______
USASCII only:	2,320	3,304	______
Both:	2,928	3,920	______
Types 2 and 3 scanners			
EBCDIC only:	N/A	5,008	______
USASCII only:	N/A	4,648	______
Both:	N/A	5,264	______
Type 3 scanner only			
EBCDIC only:	N/A	2,704	______
USASCII only:	N/A	2,704	______
Both:	N/A	2,704	______

Total binary synchronous support: ______

Line Trace Option

Choose the applicable option:

	Type 1 CA	Type 4 CA	
Type 1 scanner:	1,664	N/A	______
Type 2 scanner:	1,704	N/A	______
Type 3 scanner with or without type 2 scanner:	N/A	1,688	______

If you include the line trace option, you should provide enough additional storage to trace one line entry for every line being traced. An entry is either a level 1, level 2, or level 3 interrupt, and each entry requires one or more of the following:

For a type 3 scanner,
(8 x (3 + n) x number of level 2 entries): ______
where n is 0 if no data transfer or n is the
number of eight-byte entries
sufficient to contain the type 3 scanner buffer
(1 ID byte plus 7 data bytes per entry)
Plus, for type 1 or 2 scanners,
(16 x number of level 2 entries): ______
(8 x number of other type entries): ______

Dynamic Dump Option

Dynamic Dump (DYNADMP):

	Type 1 CA	Type 4 CA	
Using native subchannel only:	1,008	1,080	_____
Using any other subchannel:	1,040	1,222	_____

Test Option

Panel Test (TEST):

	Type 1 CA	Type 4 CA	
Type 1 scanner without auto call:	1,184	N/A	
Type 1 scanner with auto call:	1,488	N/A	
Type 2 scanner without auto call:	1,128	3,344	
Type 2 scanner with auto call:	1,416	3,344	
Types 2 and 3 scanners with or without autocall:	N/A	3,824	_____
Type 3 scanner only with or without autocall:	N/A	2,288	_____

Total test option: _____

Character Control Block

Emulation mode for NCP 2 or NCP 5 and EP/VS 3 requires a character control block for each line in your configuration. (Storage for the character control block is required regardless of the communication scanner type used.) The character control block contains current information, primarily on the physical operation of the line. Figure 4-1 shows the character control block storage estimates for each line and its possible options. Select the size applicable for each line.

Every character control block is associated with a particular subchannel address; however, every subchannel address within the range of the high and low subchannel addresses configured does not necessarily apply to a line. Any subchannel address within the range of the high and the low subchannel address not associated with a line is a *skipped subchannel address.* Note, however, that each MSLA subchannel is associated with a line and its dummy character control block's size is 12 bytes (instead of the 10 bytes for a skipped subchannel address that is not associated with any line.) Skipped subchannel addresses require dummy character control blocks, each of which occupies 10 or 12 bytes of storage.

The procedure for calculating storage estimates for the character control blocks is as follows:

1. From Figure 4-1, determine the storage estimate for each line in emulation mode: _____
2. Add all individual line estimates: _____

	BSC lines Bytes		Start-Stop lines Bytes	
Type 4 channel adapter and Type 3 communication scanner	42 + (2 x CS3 buffer size) [CS3 buffer size may be 4, 8, 16, 32, 64, 96, 128, 160, 192, or 224]		N/A	
	Type 1 CA	Type 4 CA	Type 1 CA	Type 4 CA
Type 1 or type 4 channel adapter and type 2 communication scanner high priority (CHNPRI=HIGH on the LINE macro) and additional buffer space (OPCSB2=YES on the BUILD macro).				
High priority without dual communications interface	58	60	N/A	N/A
High priority with dual communications interface	60	62	N/A	N/A
Type 1 and type 4 channel adapter and type 2 communication scanner				
Without dual communications (DUALCOM) interface, without station select[1]	42	44	38	40
With dual communications interface, with or without station select	44	46	N/A	N/A
With station select, with or without dual communications interface	46	48	N/A	N/A

[1] Station select is indicated when you specify TADDR on the LINE macro.

Figure 4-1. Character Control Block Storage Values

3. Compute the dummy character control blocks as follows:
   For a type 1 channel adapter, multiply the number of skipped subchannels by 10 bytes: ______
   For each type 4 channel adapter,
   multiply the number of skipped subchannels by 10 bytes: ______
   multiply the number of unassigned multiple subchannel line access (MSLA) subchannels by 12 bytes: ______

Add the sum from step 2 to the product(s) of step 3: ______

Total character control block estimates: ______

Example:

A communications controller with a grouping of subchannel addresses falling within address X'00' and address X'3F' has 64 subchannel addresses for lines. Assume these lines are start-stop, and 54 of the addresses are associated with lines and 10 are not. The storage for the character control blocks is calculated as follows:

1. The storage estimate for start-stop lines is 38 bytes.
2. Since all lines are the same, 54 subchannels x 38 bytes = 2,052.
3. There are 10 skipped subchannels. 10 subchannels x 10 bytes = 100.
4. 2,052 (from step 2) + 100 (from step 3) = 2,152 bytes.

Tables

Emulation mode requires the following three tables:

- Channel vector table
- Line vector table
- Line group table

Channel Vector Table

The channel vector table (CHVT) translates the multiplexer subchannel address to the corresponding communication scanner line interface address.

The CHVT is a variable length table. Its size depends on the highest subchannel address assigned to the program.

Determine storage estimates as follows:

For a type 1 channel adapter,
10 bytes +((high-low subchannel address) x 2)
+(number of scans x 2) ______

For each type 4 channel adapter,
112 bytes + ((high-low subchannel address) x 2) ______

Example:

Assume that you have a type 1 channel adapter where the high subchannel address is X'54' and the low subchannel address is X'22' and that you have two communication scanners installed. (Converting to decimal: X'54' = 84; X'22' = 34).

Using the formula:

10 bytes + ((84 - 34) x 2 bytes) + (2 x 2 bytes) = 114 bytes of storage required.

Line Vector Table

The line vector table is used to index to the corresponding character control block once a line interface address is known. It also contains the fields and pointers required by the type 1 scanner control program. The length of the line vector table depends on the highest line interface address specified. Calculate storage for the line vector table as follows:

For type 1 scanner:
(Highest line address in decimal + 1) x 16: ______

For type 2 scanner with a type 1 channel adapter:
(Highest line address in decimal + 1) x 2: ______

For a type 2 and/or a type 3 scanner with a type 4 channel adapter:

((Highest line address in decimal + 1) x 2) +16 ______

Total for line vector table ______

Assume you are using the highest possible address on a type 1 communication scanner—X'03F' (63 in decimal notation).

Using the formula:

(63 + 1) x 16 = 1,024 bytes of storage.

Assume you are using the highest possible address on a type 2 communication scanner—X'05F' (95 in decimal notation), and that you have a type 1 channel adapter.

Using the formula:

(95 + 1) x 2 = 192 bytes of storage.

Line Group Table

The line group table (created by GROUP macro) contains the parameters a group of lines have in common.

Allow eight bytes for every GROUP macro. ______

Total NCP 2 or NCP 5 Storage Estimates for Emulation Mode (TYPGEN=EP)

Total storage estimate for emulation mode (NCP 2 or NCP 5): ______

If applicable, transfer the storage total for lines operating in network control program mode and emulation mode to the space provided below.

Total NCP 2 or NCP 5 Storage Estimates (TYPGEN=PEP)

Subtotal network control program:			______	
Subtotal emulation program:			______	
For type 1 channel adapater with a type 1 scanner, *subtract*:	624	______		
For type 1 channel adapter with a type 2 scanner, *subtract*:	670	______		
For a type 4 channel adapter with a type 2 and/or a type 3 scanner, *subtract*	856	______		
If NCP shares the type 1 or type 4 channel adapter, *add*:	100	______		
Subtotal adjustments:			______	
Total adjusted NCP storage:				______

For NCP line mode switching, add:	544	______		
Line trace for emulation lines, add:	160	______		
Panel-initiated line test, add:	144	______		
Total NCP options:			______	
Total storage estimate:				______

Chapter 5: Planning for Performance for NCP

This chapter describes the NCP generation operands that affect performance of the communications controller when operating under NCP 1, NCP 2, or NCP 5 (hereafter referred to as the network control program or NCP unless distinguished in the text). Performance in the controller is largely determined by the proper choice (where your system permits) of operands that control the following system functions:

- Data transfer between the host processor and the controller over the channel
- Processing of data within the controller
- Data transfer between the controller and terminals over communication facilities

Data Transfer over the Channel

The number of times the network control program has to be interrupted to transmit or receive data is an important consideration when specifying the buffers in both the communications controller and the host processor.

The network control program must know:

- How much data the teleprocessing access method can accept in one continuous transmission
- How many buffers to allocate in the controller for each data transfer from the host

The host access method's buffer size determines the maximum amount of data that can be transferred across the channel from the controller on a single host Read command. The network control program operands concerned with this facility are MAXBFRU, UNITSZ, and BFRPAD on the HOST macro. MAXBFRU is the number of buffer units that the access method will allocate for receiving a single data transfer from the NCP, and UNITSZ is the size of each buffer unit (in bytes) used by the access method. BFRPAD is the number of bytes included for use by TCAM. Data can be transferred to the host as it becomes available, or it can be blocked and transferred after a time interval (specified in the DELAY operand) has expired.

Channel Attention Delay (Local Only)

The DELAY operand on the HOST macro specifies the interval, to the nearest tenth of a second, that the network control program will delay sending an Attention signal to the host processor after data has become available. This delay ensures, if specified correctly for your network, that the interrupts to the host processor are kept to a minimum.

As the network control program begins to fill its buffers, the delay feature waits for the specified period before raising an Attention to the host. If the amount of data is sufficient to fill the buffers allocated by the host processor, the Attention interrupt will be presented before the delay count has been reached.

Data Collection Applications

In data collection applications, terminal operators usually supply data to the host processor without waiting for a text reply.

For example, the transactions that produce records in a bank can be gathered into channel transfer units to be shipped to the host for processing later. Because controller delays are not usually critical in this application, a high channel atten-

tion delay would probably be sufficient. This delay allows the network control program buffers to fill, but it does not allow excessive time to expire before their contents are transferred to the host processor. The delay is overridden if the buffers fill (as a result of message traffic intensity) before the specified time runs out.

Conversational Applications

A conversational (inquiry/response) application usually involves terminals interacting with an application program running in the host processor. Response time at the terminal is important; therefore, the delay feature should be short, for example, approximately 0.1 to 0.5 second.

There is a need to balance the load (as defined by percent utilization), the buffer size, and the attention delay for each application. For example, a heavily loaded NCP with a small host access method buffer size and an insufficient number of host access method buffers will be continuously interrupting the host with Attention signals. Even a long attention delay will constantly be overridden in this situation.

Specifying DELAY, UNITSZ, BFRPAD and MAXBFRU at Generation Time (Local Only)

Choose the most appropriate values for DELAY, UNITSZ, BFRPAD, and MAXBFRU by performing an analysis of the characteristics of your network and application to determine the average number of bytes per message and the average number of messages per second.

For example, assume an average message size of 25 bytes. Multiply the average by 1.5 to obtain a buffer unit size that will handle approximately 75 percent of the traffic without wasting buffer space. Add the required buffer pad to the product; the value is now 37 plus 30 for the buffer pad, or 67 bytes. Specify UNITSZ (the size of a TCAM buffer) as 67.

Assume also, an attention delay of 0.8 second (800 milliseconds) is acceptable for your application; specify DELAY as 0.8.

Assume an average of 21 messages per second.

DELAY times messages per second = MAXBFRU (the number of TCAM buffers); that is, 0.8 x 21 = 16.8 (rounded up to 17).

The above calculations yield the following operand values:

UNITSZ=67
MAXBFRU=17
DELAY=0.8

The values for UNITSZ and MAXBFRU operands, once determined, must also be used in the buffer specifications for the access method to permit the most efficient utilization of the host and transfer of data over the channel.

Subchannel Service Priorities for TYPGEN=PEP or EP

Subchannel service priorities are those priorities the communications controller services internally in emulation mode. They are assigned at generation time, for TYPGEN=PEP or EP, by coding CHNPRI=NORMAL or HIGH on the LINE macro.

When the highest speed line is less than or equal to 9,600 bps, all lines may be assigned to the NORMAL priority; however, performance is about 1.0% better if they are all assigned to the HIGH priority.

When the highest speed line is greater than 9,600 bps, all lines of speed less than or equal to 9,600 bps should be assigned to the NORMAL priority, and all lines greater than 9,600 bps must be assigned to the HIGH priority, with the following exception. When the highest speed line is greater than 19,200 bps (20,400 bps for non-U.S.A), the 19,200 or 20,400 bps line and lower speed lines should be assigned to the NORMAL priority, and the higher speed lines should be assigned to the HIGH priority.

Device Priority on the Byte Multiplexer Channel

The communications controller is an "overrunnable" device while operating in either emulation or partitioned emulation programming extension mode. It should have the highest priority on the byte multiplexer channel; that is, the controller should be the first device to secure the *select out* signal.

When multiple communications controllers are placed on the same channel, the controller with the highest speed lines and the most heavily used lines should be positioned to secure the *select out* signal first on the channel.

Communications Controller Performance

Local communications controller performance is affected by the size and frequency of data transfers from the host processor. The controller needs sufficient buffer space to support these transfers. The INBFRS operand of the HOST macro specifies the number of controller buffers initially allocated for each data transfer to be received from the host processor.

When estimating a value for INBFRS, consider two factors:

1. If the size of a data transfer consistently exceeds the allocated buffer space, the network control program supervisory routine is frequently interrupted to provide more buffers for the excess data in the block. As the proportion of time the network control program spends in allocating buffers increases, supervisory service requirements of the network control program increase and performance may suffer.
2. If the amount of data received is consistently less than the allocated buffer space, many buffers are not used. Although the unused buffers are eventually used for receiving the next data transfer, their absence from the buffer pool lowers the overall efficiency of buffer utilization.

In choosing a value for INBFRS, you should strike a balance between possible degraded network control program performance due to excessive demands on the supervisory routine, and unnecessary over-allocation of buffers.

Preventing a Monopoly of Buffers for BSC and Start-Stop Stations

All buffer requests in both the local and remote controllers are filled from a single pool, and no station should monopolize the supply to the exclusion of other stations.

You can prevent buffer monopolization with the TRANSFR and CUTOFF operands on the LINE macro. A terminal may have a slow data rate or large messages; if so, the network control program can control reception of data from the station by limiting the number of buffers filled before sending the data to the host processor. The TRANSFR operand limits the number of buffers that a

station on a line can fill to send to the host in a single transfer; this limited number of buffers is called a sub-block. (A sub-block is a logical group of buffers that does not contain a complete message.)

The CUTOFF operand limits the total number of sub-blocks a station on a line can send as the result of a single host Read command.

The network control program determines the maximum value for the TRANSFR operand based on the maximum size of the channel transfer unit. (A channel transfer unit is the amount of data transferred to or from the host processor by a single start I/O.) To improve performance you may have to change the buffer size of the access method. For example, the access method may not have enough buffers to allow the network control program to perform at peak efficiency.

Segmentation of Data Transfers for SDLC Stations (NCP 5)

The maximum amount of data that the NCP can send and a cluster controller can receive is specified in the MAXDATA operand on the PU macro. The buffer size of the cluster controller and MAXDATA in the NCP should be equal to the most common message size received by the cluster controller. If messages larger than the cluster controller's buffer size are transmitted, the NCP must send them in smaller segments. This segmentation of messages requires more processing; therefore, the most efficient operation of the link is achieved when MAXDATA is equal to the buffer size of the cluster controller.

Network Slowdown

The network control program in both the local and remote communications controllers must have buffers available to receive data. Overloads can occur in which the program receives more data than it can send. If the overload is protracted, the network control program will exhaust its supply of buffers. The supply of buffers in the local communications controller supporting a remote communications controller can be exhausted quickly if the local controller does not have sufficient buffer space available to process the data coming from the remote controller and the stations attached to the local controller.

The network control program continuously monitors its supply of buffers, and when the supply reaches a specified level, the network control program automatically enters *slowdown mode.* In slowdown mode, the program reduces the amount of data it receives from the network and the access method, but it continues to perform those functions, such as sending, which result in buffers being released. In this way, a net gain in the number of available buffers is achieved. When the buffer supply is replenished, the program automatically resumes normal operation.

The SLODOWN operand on the BUILD macro determines at what stage of buffer pool exhaustion the network control program will enter and exit slowdown mode. Most systems, having a sufficiently large buffer pool and a variety of terminals transmitting and receiving messages in a random fashion, should use the 12 percent value for SLODOWN.

If the system goes into slowdown mode too often, then more buffer space may be necessary or, where applicable, pacing requirements may have to be modified. See the discussion on pacing under "Pacing for SDLC Stations (NCP 5)." The amount of buffer space available is the difference between the size of the network control program load module (plus user-written code) and the size of storage in the controller.

Data Security Option

Unless data security is required in controller storage, do not choose the security option for controller storage (by the CDATA operand on the TERMINAL macro). The option creates performance overhead in the network control program because each buffer released to the free buffer pool must be cleared of residual data.

Processing within the Communications Controller

The network control program optionally processes data passing through the controller with block handling routines. Block handling refers to the optional processing of message data received from the host processor for retransmission to a station, or of message data received from stations for forwarding to the host processor. Typical block handling options are automatic text correction and insertion of date and time. Because these options require machine cycles and storage, they should be specified only when necessary.

Block Handling Routine Considerations for Local BSC and Start-Stop Lines

The block handling routine can be specified at various logical points (PTs) in the network control program's processing. You can specify PT1, PT2, PT3, or ALL on the BHEXEC operand of the appropriate TERMINAL, COMP, or CLUSTER macro.

If you specify PT1, the block handling routine will be processed for host Write commands before the line has been allocated. If you specify PT2, the block handling routine will be processed for host Read and Write commands, and the line will remain allocated during the processing. If you specify PT3, the block handling routine will be processed for host Read commands after the line has been released. Unless there is a requirement to have this line allocated during block handling routine execution, processing at PT1 or PT3 will allow for more effective use of the line. However, if you specify PT3, you can slow processing down in a heavily loaded system because PT3 occurs just before the data is sent to the host processor. The data will not be transferred until all of the processing on that block is completed; therefore it is possible that queuing will occur, and buffer space for the queued data will be required. PT3 also requires additional storage because another control block is required for each affected device.

Therefore, where a choice exists between processing at PT2 or PT3 and where line utilization is not a factor, PT2 is the better choice.

Data Transfer over Communications Facilities

Optimum performance in the communications controller depends on the efficient use of communications facilities connecting the controller to outlying stations. Line utilization depends on the amount of information passing over these facilities.

Nonswitched BSC and Start-Stop Multipoint Lines

Service order table entries are those that determine the order in which the network control program attempts to communicate with stations on a line. This table is defined by the SERVICE macro coded immediately after the LINE macro representing the multipoint line. Nonswitched multipoint lines may be used more efficiently by not grouping multiple service order table (SOT) entries for the same device. For example, terminals A, B, and C, should be specified as ABC ABC ABC rather than AAA BBB CCC. A station may also be assigned more than one entry to achieve a higher degree of priority for the station and also to achieve load

balancing on an SDLC link; load balancing reduces the number of unproductive polls and improves overall efficiency.

The network control program can be kept responsive to application requirements by including the *change session initiation information* control option (using the SESINIT dynamic control facility on the SYSCNTRL macro). This option allows the contents of the service order table to be changed during program execution by an operator control request from the host processor. Control requests can cause the program to add or delete devices or change the order or frequency in which the devices are serviced.

In general, two multipoint lines with two terminals each are more efficient than a single line with four terminals because concurrent input and output operations can be scheduled on two lines; however, the correct use of the SESSION operand on the LINE macro will greatly improve the efficiency of a line with more than two terminals.

The Session Limit for BSC and Start-Stop Multipoint Lines

The number of concurrent sessions to be conducted on a multipoint line is called the *session limit* (specified by the SESSION operand on the LINE macro). This limit depends on several factors. Among these factors are:

1. The relative amount of time that a terminal in use does not need the communication line.
2. The permissible delay between readiness to use the terminal and the availability of the communication line.

The capability of the network control program to conduct multiple sessions on the same multipoint line depends on the possibility of data transfers not occurring continuously during the session.

While message data is being entered into the terminal's buffer or the terminal is printing the contents of the buffer, the terminal has no need for the communication line. The terminal, therefore, needs the line for relatively small portions of the session period. The line can be used for servicing other terminals in the interim.

Interleaving transmissions with several stations gives maximum use of a multipoint communication line.

In general, if the rate of message transfers between the network control program and terminals on the line is low, then the session limit should be set high. However, care should be taken not to set it so high that the number of sessions on the line lengthens response time at the terminal. If the message transfer rate is high, the session limit should be set low.

Delay from BSC Terminals

Delays due to various conditions at BSC terminals may cause excessive use of a multipoint line by a single terminal. You should consider:

1. The maximum number of times that the BSC temporary-text-delay (TTD) sequence is to be received from a station before the operation is to be aborted.
2. The maximum number of times that the BSC wait-before-transmit (WACK) sequence is to be received before the operation is to be aborted.

In general, lower TTD limit and WACK limits are preferred because this reduces the time that one terminal controls the line. These options are specified, respec-

tively, in the TTDCNT operand and the WACKCNT operand on the GROUP macro.

Transmission Limit for BSC and Start-Stop Multipoint Lines

Transmission limits (specified on the XMITLIM operand of the TERMINAL and COMP macro) depend more on the application than on any other factor. A card reader sharing a line with other devices might monopolize the line with a high transmission limit; therefore a low transmission limit would promote greater line sharing. An inquiry/response application with a transmission limit of one would cause the terminal operator to have to wait for the response to an inquiry until the next session was established. A data collection application, on the other hand, is well suited to a transmission limit of one as no response is necessary in most cases. As a general rule, transmission limit should be specified according to the requirements of the types of devices sharing a line or according to the type of application sharing the line.

Pass Limit for SDLC Stations (NCP 5)

The pass limit for duplex stations (PASSLIM on the PU macro) specifies the maximum number of blocks which can be sent to an SDLC station for a given entry in the Service Order Table. The pass limit is analogous to the transmission limit for BSC terminals on multipoint lines.

A large pass limit causes the line to be dedicated to a station for a long time before the NCP attempts to service another station. A large value should not be specified in applications where response time is critical.

A small pass limit causes each station on the line to receive frequent service from the NCP. A small value should be specified in applications where response time is critical.

Maximum Unacknowledged Transmissions (NCP 5)

The number of blocks that can be outstanding, without being acknowledged, is specified by the MAXOUT operand on the PU macro. A low value should be specified if the quality of the line is not high to avoid having excessively large blocks retransmitted due to error conditions.

If the quality of the line is high, a large value will yield the best results.

Text Error Recovery

To ensure maximum use of a line, error retry limits (using the RETRIES operand on the LINE macro) should generally be kept low, with no pause for multipoint lines. Once the retries are exhausted, the line is allocated to another terminal.

Buffer Delay for BSC and Start-Stop Buffered Stations

Some types of IBM BSC and Start-Stop stations receive incoming data into buffers at high speed, then print or otherwise display the data at a much slower rate. If the network control program has multiple data blocks to send to the same terminal, it must wait after sending each block for the terminal to print the contents of its buffer before it is able to send the next block. If the line is a multipoint line, the network control program can use the time the line would otherwise be idle for communicating with other terminals. That is, at any given moment the program can be sending to one of several terminals while the others are printing data received earlier.

If your network includes stations of this kind, code the delay (in seconds) on the BFRDLAY operand of the TERMINAL macro. The value you specify should equal the length of time the terminal needs to print the contents of its buffer.

Control of Nonproductive Polling

BSC and Start-Stop Lines

Two LINE macro operands, PAUSE and NEGPOLP, are available to control nonproductive polling on BSC and start-stop lines. The PAUSE operand specifies the amount of time that may elapse after the service limit value (specified by the SERVLIM operand) is reached, if no session is active on the line. The NEGPOLP operand, which is used only for BSC multipoint lines, specifies the amount of time that may elapse after the NCP receives a negative response to polling, before polling is resumed. Both of these operands limit nonproductive polling and reduce the processing overhead associated with such polling. You should specify values for the PAUSE and NEGPOLP operands to correspond with the expected negative responses to polling. If you expect most polls to receive negative responses, set the pause interval relatively high; this will reduce the processing overhead associated with such responses. However, too large a pause value can increase the response time experienced by operators of terminals on the line. If the line is so busy that terminals on the line will usually be ready when they are polled, there should be little or no pause. If you specify an integer for NEGPOLP, then you should also specify PAUSE=0 (or let it default to zero) to avoid increasing response times at the terminals. For lines with many terminals, responses can be slowed significantly with even small values specified for NEGPOLP.

SDLC Lines

The PAUSE operand of the LINE macro is available to control nonproductive polling on SDLC lines. PAUSE (for SDLC) specifies the minimum duration of the polling cycle. The polling cycle extends from the moment polling begins with the first active entry in the service order table to the moment polling next begins at the same entry. If the time expended in servicing all the active entries in the service order table equals or exceeds the PAUSE value, the next polling cycle begins immediately. On the other hand, if the time expended in servicing all the active entries in the service order table is less than the PAUSE value, the next polling cycle is deferred until the time defined by PAUSE has expired. Allowing a pause to elapse when activity on the line is relatively low reduces the amount of processing time consumed by nonproductive polling. However, too large a PAUSE value can increase the response time experienced by operators of terminals on the line.

Pacing for SDLC Stations (NCP 5)

The pacing option is a means of regulating the flow of data between the host logical unit (primary LU) and the cluster controller's logical unit (secondary LU). The VPACING operand controls the flow of data blocks from the primary LU to the communications controller. The PACING operand controls the flow of data blocks from the communications controller to the secondary LU. Both VPACING and PACING are specified on the LU macro during NCP generation. (See the appropriate VTAM *System Programmer's Guide*, listed in the Preface of this manual, for information on how to code the VPACING operand.)

Pacing is used to prevent situations that can occur when, for example, the primary LU sends data into the network faster than the NCP can transmit it to the secondary LU or faster than the secondary LU can process it. Eventually the primary LU may flood the network with data, either forcing the NCP into slowdown

mode, or exhausting the buffer supply in the cluster controller. Proper specification of the VPACING and PACING operands can prevent such situations occurring in your system.

Both the VPACING and the PACING operands have two suboperands, *N* and *M*. For VPACING, *N* denotes the number of blocks the primary LU is to send to the NCP before stopping to await a pacing response from the NCP. *M* specifies in which of the *N* blocks the primary LU is to turn on the pacing bit in the block header, indicating that it expects a pacing response when the NCP is able to accept more blocks.

Similarly, for the PACING operand, *N* denotes the number of blocks the NCP is to send to the secondary LU before stopping to await a pacing response. *M* specifies in which of the *N* blocks the NCP is to turn on the pacing bit.

Specific recommendations cannot be made for specifying particular values for *M* and *N* because the effect of pacing depends on many factors, such as:

- The speed at which the primary LU can generate data for a particular secondary LU.
- The speed of the communications line between the NCP and the cluster controller that owns the secondary LU.
- The number of cluster controllers on the communications line.
- The structure of the service order table for the communications line.
- The PASSLIM and MAXOUT attributes of the cluster controller. (See descriptions of these attributes in this chapter.)
- The number of logical units at the cluster controller.
- The speed at which the secondary LU can process data.

All of these factors need to be considered in selecting values for PACING and VPACING. Figure 5-1 will aid in this selection. See Appendix A for a detailed example of how pacing works.

Figure 5-1 below lists some advantages and disadvantages of specifying various relative values of *M* and *N*. As a general rule, *N* should be as small as possible to prevent tying up buffers unnecessarily in the NCP or the cluster controller receiving the requests; *M* should be equal to or relatively close to the value specified for *N* to prevent buffer usage build-up in the receiving NCP or cluster controller. The most efficient values for *M* and *N* would allow the NCP to stay one request ahead of the requirements of each logical unit.

CONDITION	*ADVANTAGE*	*DISADVANTAGE*
1. VPACING M & N		
N=small value	Ties up relatively little NCP buffer space.	Less likely that NCP will be able to stay one request ahead of LU.
N=large value	NCP is more likely to have a request on hand when the LU is ready to process one.	Requests in NCP awaiting processing by the LU ties up storage. Since *N* is specified by LU, the total impact on NCP buffer usage will be the sum of the buffers tied up for all the LUs at that NCP. This total may deplete buffers to a point where NCP enters slowdown. This condition should be avoided, and can be remedied by increasing NCP storage or lowering *N* for the LUs.
M<N	Promotes relatively steady flow of requests for LU from Host, since the time between transmission of nth request by the Host and receipt of pacing response by the Host is lessened.	More likely to tie up NCP buffer space; if pacing response is received before the nth request is generated, no real pacing occurs.
M = N	Less likely to tie up NCP buffer space, since the time between transmission of nth request by the Host and the receipt of pacing response by the Host is widened.	Flow of requests from Host less likely to be steady, since the likelihood of host having to wait for pacing response is increased.
2. PACING M & N[1]		
N=small value	More likely that the NCP will be able to stay one request ahead of the LU.	Requests are more likely to linger in NCP, tying up storage.
N=large value	Ties up relatively little NCP buffer space, since requests are sent to the LU more rapidly.	Less likely that NCP will be able to stay one request ahead of the LU.
M<N	Less likely to tie up NCP buffer space, since the time between transmission of nth request by the NCP and the receipt of the pacing response is lessened. Also, flow of requests from NCP to LU is relatively steady.	More LU buffer space will be required.
M = N	Less LU buffer space may be required.	More likely to tie up NCP buffer space; flow of requests from NCP to LU is less steady.
M = 0 N = 0 (no pacing)	Will provide data to the secondary LU as fast as it can receive it.	More likely to tie up NCP buffers because the NCP has no control over the rate at which the host sends blocks of data to the NCP.

[1]The values specified here are in some cases dictated by the secondary LU. For this reason some of the advantages listed are unattainable.

Figure 5-1. Advantages and Disadvantages of Various Relative Pacing Values of M and N

Appendix A: Example of Pacing

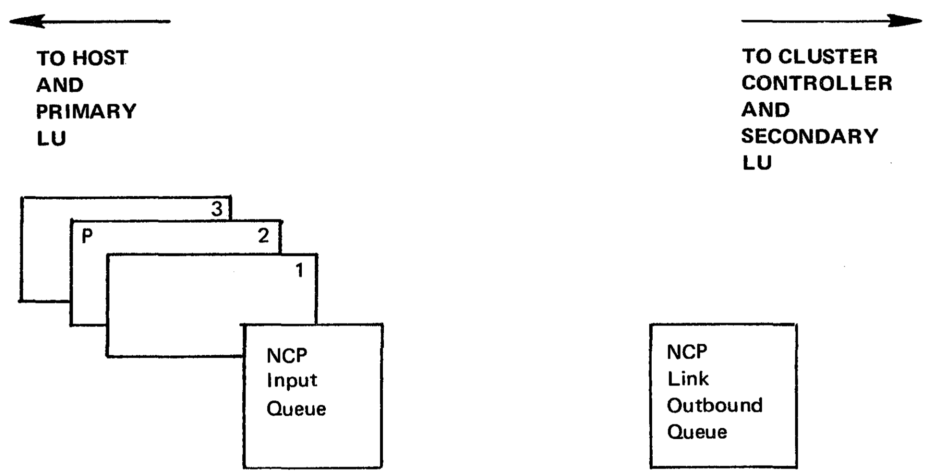
The following example illustrates the way in which the NCP participates in pacing. The example is for the case:

LU VPACING=(3,2),PACING=(2,1)

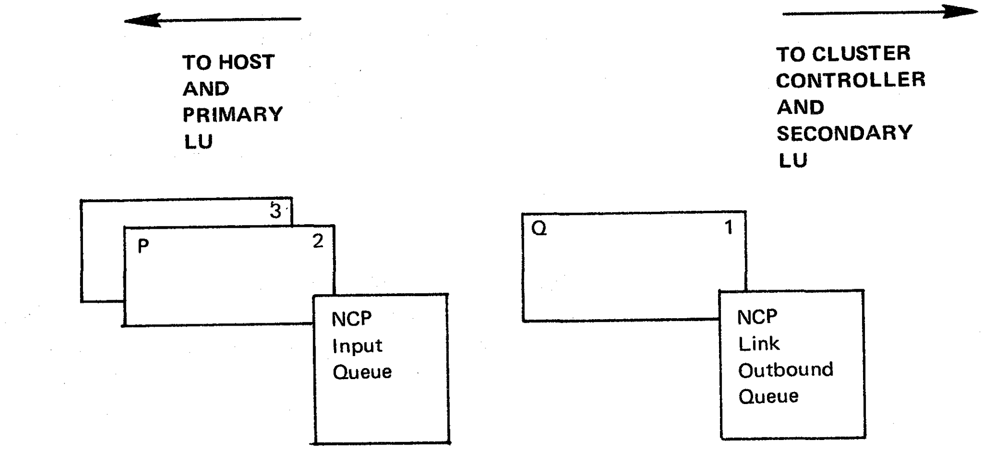
The example assumes that the primary LU has an unlimited supply of data for the secondary LU. For simplicity, this example excludes expedited blocks and response blocks.

Each block in the example is numbered as it is sent from the primary LU. *P* indicates the presence of the pacing indicator on a block as it passes from the primary LU to the NCP. (The example assumes that the pacing indicator is present on blocks that require exception responses only.) *Q* indicates the presence of the pacing indicator on a block as it passes from the NCP to the secondary LU.

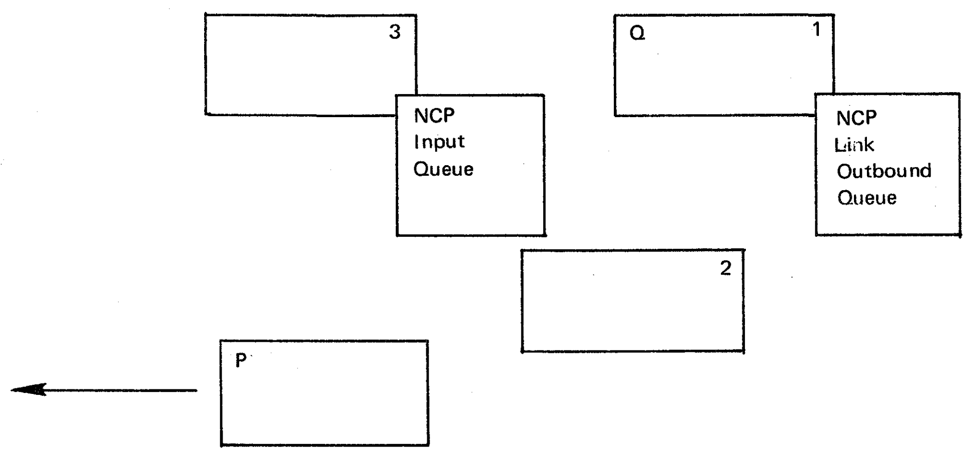
The NCP begins operation not in "awaiting pacing response" state for this secondary LU. The NCP keeps a counter, called "pacing *N*." At the beginning of the example this counter is initialized to 2, the value *N* in the PACING operand.



1. Since the primary LU is not currently waiting for a pacing response, it sends three (N=3) blocks to the NCP. The pacing indicator is present on the second block (M=2) (where VPACING=(3,2) applies to the primary LU).

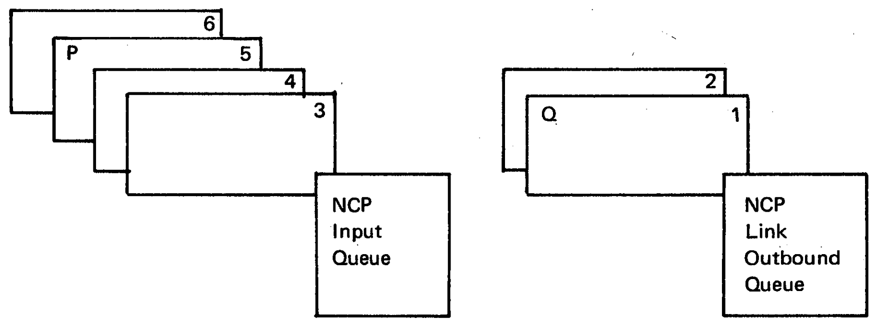


2. The NCP fetches the first block on the input queue for this secondary LU. The NCP decrements its pacing *N* counter by one. It notes that block *M* has been reached, and it sets the pacing indicator *Q* in this block. The block is scheduled for transmission to the cluster controller.

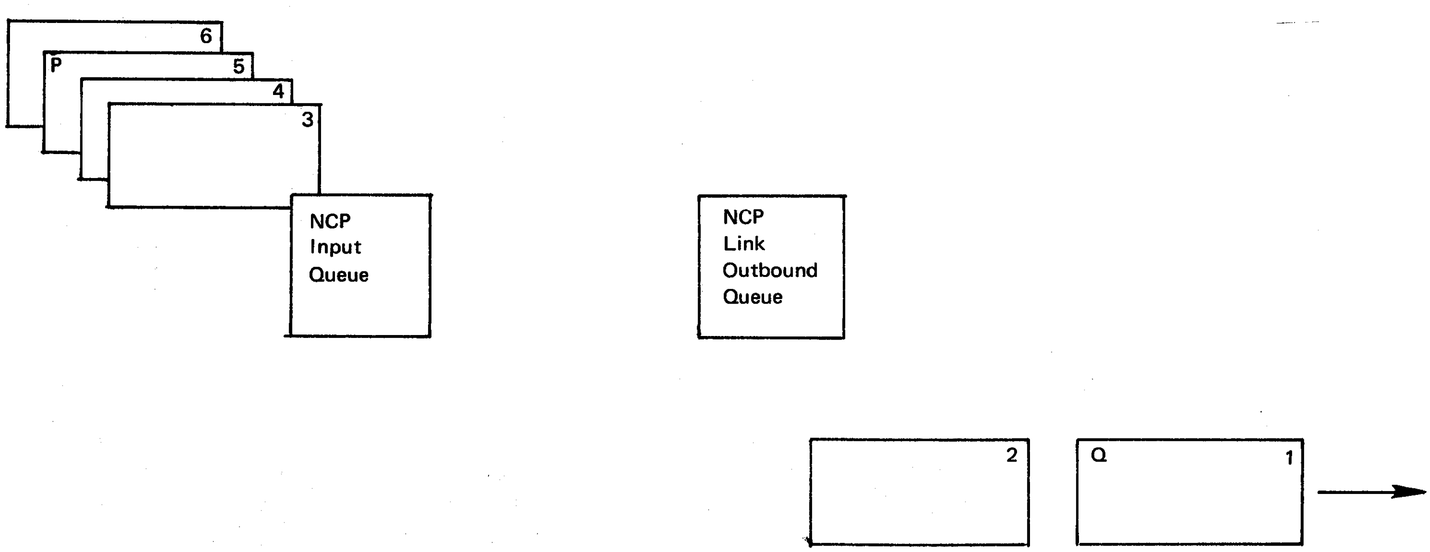


3. Since the NCP pacing *N* counter is not zero, the NCP gets the next block from the input queue and processes it. The pacing *N* counter is decremented by one. It notes that the pacing indicator *P* is on.

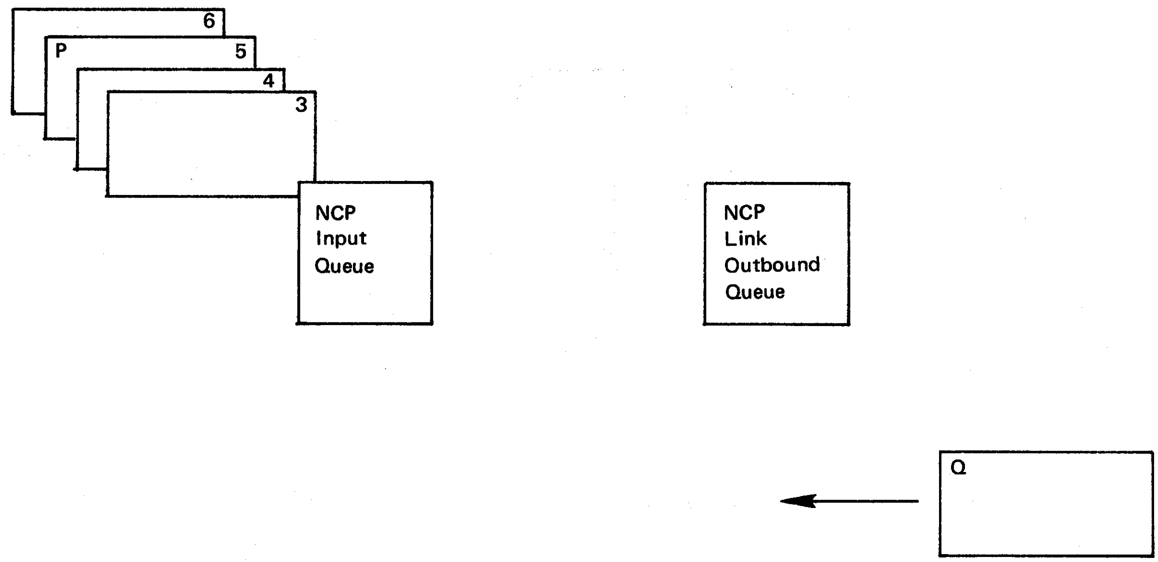
   The NCP generates an "isolated pacing response" and sends it to the primary LU.



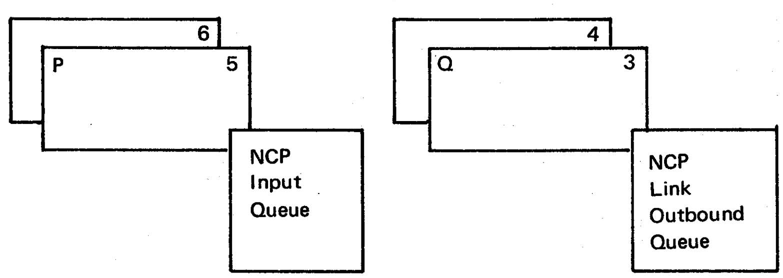
4. Since pacing *N* has now been satisfied, the NCP enters the "awaiting pacing response state." No other blocks will be removed from the input queue until a pacing response is received from the secondary LU. Concurrently, the NCP receives VPACING *N* additional blocks from the primary LU.



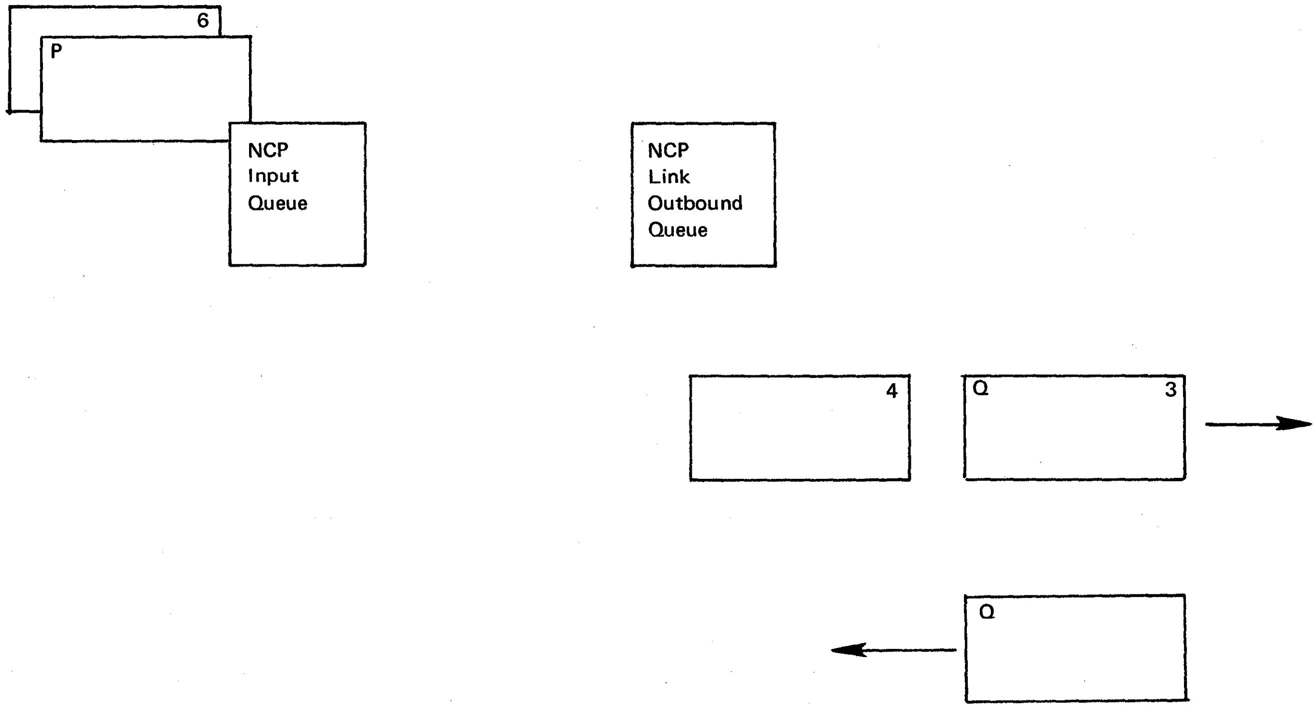
5. Blocks 1 and 2 are transmitted to the cluster controller. Eventually they are processed by the secondary LU.



6. The secondary LU notes that the pacing indicator Q is present in block 1, and it returns a pacing response Q to the NCP. This response authorizes the NCP to send pacing N more blocks to the secondary LU (where PACING=(1,2) applies to the secondary LU).

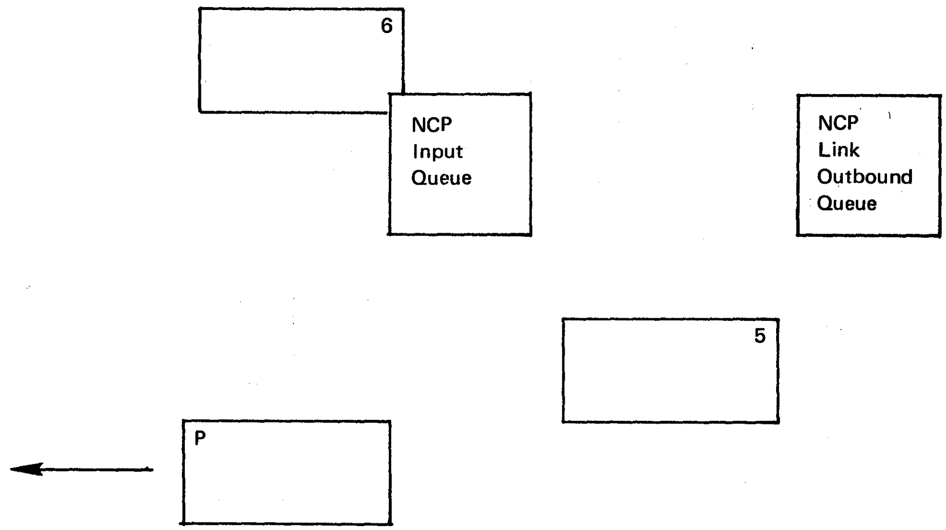


7. The NCP leaves the "awaiting pacing response" state and initializes its pacing N value to two. Since pacing N is not zero, the NCP fetches the next block from the input queue and processes it, decrementing pacing N by one. The NCP notes that it has reached block M and sets the pacing indicator in this block. Since the pacing N counter is not zero, NCP gets the next block from the input queue and processes it, decrementing pacing N by one.

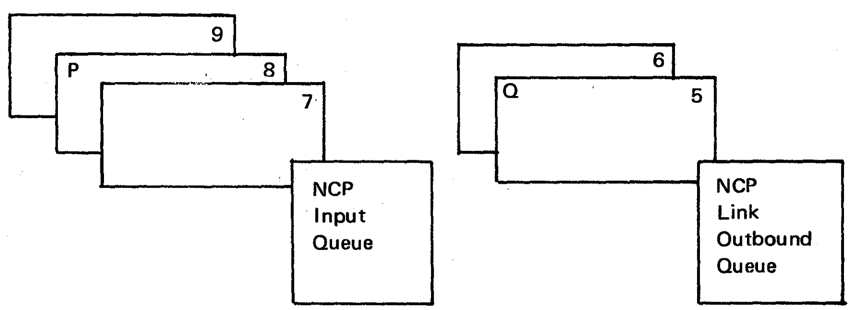


8. Since pacing N has now been satisfied, the NCP enters the "awaiting pacing response" state. No other blocks will be removed from the input queue until a pacing response is received from the secondary LU. Blocks 3 and 4 are transmitted to the cluster controller and are eventually processed by the secondary LU.

   The secondary LU notes that the pacing indicator Q is present in block three, and it returns a pacing response Q to the NCP. This response authorizes the NCP to send pacing N more blocks to the secondary LU.



9. The NCP leaves the "awaiting pacing response state" and initializes its pacing N value to 2. The NCP gets the next block from the input queue, notes that the pacing indicator P is on, and generates an isolated pacing response, which it sends to the primary LU.



10. The NCP decrements its pacing N counter by one. It notes that block M has been reached, and it sets the pacing indicator Q in this block. The block is scheduled for transmission to the cluster controller. Since the NCP pacing N counter is not zero, the NCP fetches the next block from the input queue and processes it, decrementing the pacing N counter by one.

    Since pacing N has now been satisfied, the NCP enters the "awaiting pacing response" state. No other blocks will be removed from the input queue until a pacing response is received from the secondary LU. Concurrently, the NCP receives VPACING N additional blocks.

    Blocks 5 and 6 are transmitted to the cluster controller and are eventually processed by the secondary LU. The secondary LU notes that the pacing indicator Q is present in block 5, and it returns a pacing response Q to the NCP. This response authorizes the NCP to send pacing N more blocks to the secondary LU. The NCP exits the "awaiting pacing response" state, initializes

the pacing *N* value to two, and the entire process is repeated for all subsequent blocks on the input queue.

To illustrate the effect of no pacing, consider the case where PACING=(0,0) is specified for an LU. At step 4 of the example, the NCP is not keeping a pacing *N* counter and so would not enter the "awaiting pacing response" state. Processing would continue directly to step 7. Blocks 3, 4, and 5 would be processed and scheduled for transmission. The pacing indicator *P* would cause the NCP to send an isolated pacing response to the primary LU, and the primary LU would send VPACING *N* more blocks to the NCP. The NCP would have no control over the rate at which it moved blocks from the input queue to the link outbound queue. If the rate of transmission from the primary LU to the NCP were faster than the rate of transmission from the NCP to the secondary LU, blocks would accumulate on the link outbound queue in the NCP. If too many buffers were needed to hold these blocks, the NCP might eventually be forced to enter the slowdown state.

Appendix B: Calculating Buffer Storage Estimates for SDLC Lines

The amount of buffer storage needed for each SDLC communication line in a network control program (NCP) is a function of many variables. The effect of the variables on buffer estimates depends on the application, the configuration, and the type of network synchronization (interactive or batch).

Interactive (Inquiry/Response) or Immediate Control Mode Network Synchronization

In an interactive environment, the issuer (primary or secondary logical unit) sends a single request unit (RU) and waits for a response. The response may be data (that is, another request), or it may be simply an acknowledgment. The data exchanged in this manner is hereafter referred to as *interactive data.*

The most important variables affecting buffer storage requirements in an interactive environment are:

- Block (request/response) rate
- Number of clusters and/or terminals per line
- Line speed
- Average block size
- NCP buffer size
- Number of NCP buffers required for an average block

Batch or Delayed Control Mode Network Synchronization

In a batch environment, the issuing logical unit may send many request units into the network before waiting for a response. The data exchanged in this manner is hereafter referred to as *batch data.* In the formulas that follow, only data that is outbound from the NCP into the network is considered batch data.

In the batch environment, requests will accumulate in the NCP if the host node and the network can present requests to the NCP faster than the line can handle them. In such a case, the number of requests that accumulate in the NCP will be the number the primary logical unit sends unless the number is limited by the effect of PACING and VPACING operands specified in the LU macro instruction during NCP generation.

The most important variables affecting buffer storage requirements in a batch environment are:

- The number of requests a primary logical unit will send before waiting for a response
- PACING and VPACING values specified in the LU macro during NCP generation
- Number of LU-to-LU sessions concurrently active on one line
- Average block size
- NCP buffer size
- Number of NCP buffers required for an average block

Using the Buffer Storage Formulas

The following formulas allow you to calculate, by line, the buffer storage estimates for either a batch or an interactive environment or a mixture of both on one line.

The formulas are arranged in a series of 13 steps (A-M). The results of the earlier steps are used in subsequent steps until the final buffer storage requirement for the line is computed in step M.
Within each step you are asked first to list the variables that are needed to find a certain value. Then you are given a formula in which you use these variables to calculate the value. Each variable is given a two-digit designator identifying the step in which is it explained and the number of the variable within that step (for example, A5 is the fifth variable in step A). Sometimes, a variable is used in more than one step. In such cases, the same designator is used each time the variable recurs, and you should refer to the definition of the variable in the step where it was first used.

If the line for which you are calculating the storage estimates handles only batch data, you can skip A, E, H, and J. If the line handles only interactive data, you can skip steps F and K. If the line handles a mixture of both interactive and batch data, you may not skip any of the steps.

As the number of SDLC lines in the network increases, the results of your buffer storage calculations tend to be more conservative. However, this tendency should allow for any additional storage required as a result of queuing at the channel, which is not included in the calculations.

Buffer Storage Estimates for SDLC Lines

Step A - Inbound Utilization (Interactive Data Only)

Is the line FDX multipoint? —Yes→ Value A = $\boxed{0}$ Go to Value B

No

Average number of blocks per second during peak load ______ A1

Header length (enter appropriate value from below) ______ A2
FID2 - 9
FID3 - 5

If there will be a mixture of FID2s and FID3s on the line, use a weighted average for the header length. This weighted average must be a value between 5 and 9.

Average length of input data block in characters ______ A3

Responses per second during peak load (+FME/PACING) ______ A4

Line speed (bps)/8 ______ A5

Calculate Value A: Value A

$$((A1 \times (6 + A2 + A3)) + (A4 \times (6 + A2)))/A5 = \boxed{}$$

Step B - Outbound Utilization

Average number of blocks per second of batch data during peak load	______	B1
Header length (enter appropriate value from below) FID2 - 9 FID3 - 5	______	B2

If there will be a mixture of FID2s and FID3s on the line, use a weighted average for the header length. This weighted average must be a value between 5 and 9.

Average length of batch data output block in characters	______	B3
Line speed (bps)/8	______	B4
Average number of blocks per second of interactive data during peak load	______	B5
Average length of interactive data output block in characters	______	B6
Responses per second during peak load	______	B7

Calculate Value B:

((B1 x (6 + B2 + B3))
+ (B5 x (6 + B2 + B6))
+(B7 x (6 + B2)))/ B4 =

Value B ☐

Step C - Total Line Utilization

Calculate Value C:

Value A + Value B =

Value C ☐

Note: When line utilization is in excess of 65 to 75 percent, buffer estimates may be significantly high. This is an indication that response time may be degraded because blocks have to be queued for the line.

Step D - Ratio of Interactive and Response Data to Total Outbound Data

Calculate Value D:

(B5 + B7)/(B1 + B5 + B7) =

Value D ☐

Step E - Estimated Number of Interactive Blocks Queued for This Line

Number of clusters and/or terminals over which the interactive sessions are distributed. _____ E1

Calculate Value E:

((E1 + 2) x Value C x (1 - (0.5 x Value C)) /(1 - Value C)) x Value D (round up to next integer) =

Value E $\square$

Step F - Estimated Number of Batch Blocks Queued for This Line

Average values specified for the following operands on the LU macros for only those logical units expected to be in session in batch mode during peak load period (use integral values for M and N):

VPACING N	_____	F1
VPACING M	_____	F2
PACING N	_____	F3
PACING M	_____	F4

Number of batch sessions expected to be active concurrently during peak load period which are limited by pacing. They must satisfy the following conditions:

- Both VPACING and PACING have been specified as other than (0,0) for the affected logical units, *and*
- The average number of requests the primary logical unit sends before waiting for a response is equal to or greater than

((2 x F1) - F2) + F3. _____ F5

Number of batch sessions expected to be active concurrently during peak load period which are not limited by pacing. They must satisfy one or both of the following conditions:

- Either VPACING or PACING has been specified as (0,0) for the affected logical units, *or*
- The average number of requests the primary logical unit sends before waiting for a response is less than ((2 x F1) - F2) + F3 . _____ F6

Average number of requests the primary logical units send before waiting for a response for those LU-to-LU sessions included in value F6 . _____ F7

Number of cluster and/or terminals on which batch sessions will be active. _____ F8

Calculate Value F:

(F5 x (((2 x F1) - F2) + F3)])
+(F6 x F7) + (F8 x (F3 - F4)) =

Value F

☐

Step G - Average Input Block Size

Calculate Value G:

(A1 x A3)/(A1 + A4) =

Value G

☐

Step H - Average Output Block Size for Interactive Data

Calculate Value H:

(B5 x B6)/(B5 + B7) =

Value H

☐

Step I - Average Number of Buffers per Input Block

Value specified in BFRS operand of the BUILD macro rounded up to the next multiple of 4. _____ I1

Calculate Value I:

(Value G + 23)/ I1 (round up to next integer) =

Value I

☐

Step J - Average Number of Buffers per Interactive Output Block

Calculate Value J: Value J

(Value H + 23)/ I1 (round up to next integer) = ☐

Step K - Average Number of Buffers per Batch Output Block

Calculate Value K: Value K

(B3 +23)/ I1 (round up to next integer)= ☐

Step L - Number of Buffers for This Line

Calculate Value L: Value L

Value I + (Value J x Value E) + (Value K x Value F) = ☐

Step M - Number of Bytes of Buffer Storage Needed for This Line

Calculate Value M: Value M

Value L x (I1 + 4) = ☐

If all lines in a group have equal characteristics (that is, all variables used in calculating the buffer storage estimates are the same), calculate the storage estimate for one line and multiply by the number of lines in the group to get the total requirement for the group.

Repeat steps A through M for each SDLC line or line group in the network. Then add the results of each calculation together to get the total buffer storage estimate for SDLC lines. Enter the total in the space provided in Chapter 3.

Example of Buffer Storage Calculation for an SDLC Line

Calculate the buffer storage estimate for an SDLC communication line with the following characteristics:

- 4800 bps, half-duplex, multipoint line
- Interactive portion of line load:
  - 1 cluster node with 3 logical units (FID2) - 75% of interactive inbound and outbound
  - 1 terminal node (FID3) - 25% of interactive inbound and outbound
- Batch portion of line load:
  - 2 cluster nodes with 4 logical units each (FID2) - 80% of batch
  - 1 terminal node (FID3) - 20% of batch

Use the following values for the variables needed to calculate the buffer storage estimates:

A1 = 1 block per second

A2	=		Since there is a mixture of FID2s and FID3s flowing on the line, use a weighted average for the header length, as follows: ((9 x 0.75) + (5 x 0.25)) x (1.0/1.4) + ((9 x 0.8) + (5 x 0.2)) x (0.4/1.4) = 8.1
A3	=	40	characters (average length of input data block)
A4	=	0.4	responses per second (assume that the only responses are isolated pacing responses solicited by the outbound batch flow; response rate = average output rate (B1)/PACING M (F4))
A5	=	600	(4800 bps/8)
B1	=	0.4	blocks per second (for batch data)
B2	=		Since there is a mixture of FID2s and FID3s flowing on the line, use a weighted average for the header length, as follows: ((9 x 0.75) + (5 x 0.25)) x (1.0/1.4) + ((9 x 0.8) + (5 x 0.2)) x (0.4/1.4) = 8.1
B3	=	400	characters (average length of batch data output block)
B4	=	600	(4800 bps/8)
B5	=	1	block per second (for interactive data)
B6	=	160	characters (average length of interactive data output block)
B7	=	0	responses per second
E1	=	2	interactive clusters and terminals on the line
F1	=	2	VPACING N value
F2	=	1	VPACING M value
F3	=	1	PACING N value
F4	=	1	PACING M value
F5	=	5	sessions satisfying both given conditions
F6	=	2	sessions satisfying one of the given conditions
F7	=	2	requests before waiting for a response
F8	=	3	batch clusters and terminals on the line
I1	=	60	BFRS value rounded up to next multiple of 4

Using these values, calculate the buffer storage requirements as follows:

Step A:

$((1 \times (6 + 8.1 + 40)) + (0.4 \times (6 + 8.1)))/600$ Value A

$=(54.1 + 5.7)/600 = \boxed{.10}$

Step B: Value B

$((0.4 \times (6 + 8.1 + 400)) + (1 \times (6 + 8.1 + 160)) + 0)/600 = \boxed{.57}$

Step C: Value C

$0.10 + 0.57 = \boxed{.67}$

Step D: Value D

$(1 + 0)/(0.4 + 1 + 0) = 1/1.4 = \boxed{.71}$

Step E:

$((2 + 2) \times 0.67 \times (1 - (0.5 \times 0.67))/(1 - 0.67)) \times 0.71$

$=((4 \times 0.67 \times 0.665)/0.33) \times 0.71 = 5.4 \times 0.71 = 3.83$ Value E

Round up to next integer $= \boxed{4}$

Step F:

$(5 \times (((2 \times 2) - 1) + 1))) + (2 \times 2) + (3 \times (1 - 1))$ Value F

$=(20 + 4 + 0) = \boxed{24}$

Step G: Value G

$(1 \times 40)/(1 + 0.4) = 40/1.4 = \boxed{28.6}$

Step H: Value H

$(1 \times 160)/(1 + 0) = \boxed{160}$

Step I:

$(28.6 + 23)/60 = 51.6 \div 60 = 0.86$ Value I

Round up to next integer. $= \boxed{1}$

Step J:

$(160 + 23) \div 60 = 3.05$ Value J

Round up to next integer. $= \boxed{4}$

Step K:

(400 + 23) ÷ 60 = 7.05 Value K

Round up to next integer. = $\boxed{8}$

Step L: Value L

1 + (4 x 4) + (8 x 24) = 1 + 16 + 192 = $\boxed{209}$

Step M: Value M

209 x (60 + 4) = $\boxed{13{,}376}$

Thus, 13,376 bytes of buffer storage are required for this SDLC line.

Appendix C: Calculating Buffer Storage Estimates for Local/Remote Communication Links

The amount of buffer storage needed in the network control program (NCP) for a local/remote communication link is a function of several variables. The most important of these are:

- Type of local/remote communication link (duplex or half-duplex)
- Line speed
- Average block size
- NCP buffer size

The following formulas allow you to calculate the buffer storage requirements for a local/remote communication link. The formulas are divided into four groups:

(1) Those for calculating the buffer estimates in a local communications controller when the link is half-duplex.
(2) Those for calculating the buffer estimates in a local communications controller when the link is duplex.
(3) Those for calculating the buffer estimates in a remote communications controller when the link is half-duplex.
(4) Those for calculating the buffer estimates in a remote communications controller when the link is duplex.

Choose the group that applies to the NCP for which you are estimating storage estimates.

The formaulas in each group are arranged in a series of steps. The results of the earlier steps are used in subsequent steps until the final buffer storage requirement for the local/remote communication link is computed in the last step.

Within each step you are asked first to list the variables that are needed to find a certain value. Then you are given a formula or a graph by which to find the value, using the variables. Each variable is given a two-digit designator identifying the step in which it is explained and the number of the variable within that step (for example, B5 is the fifth variable in step B). Sometimes, a variable is used in more than one step. In such cases, the same designator is used each time the variable recurs, and you should refer back to the definition of the variable in the step where it was first used.

Buffer Storage Estimates for Local/Remote Communication Links

(1) Local Communications Controller Estimates—Half-Duplex Link

Step A - Number of Buffers per Block

Average block size for local-to-remote traffic on the local-remote communication link _____ A1

Value specified in the BFRS operand of the BUILD macro for the local NCP, rounded up the nearest multiple of 4, plus 4 _____ A2

Calculate Value A: Value A

(A1 +30)/(A2 - 4) (rounded up to next integer) = $\square$

Step B - Total Utilization of Local/Remote Communication Link

Average output rate (local-to-remote) in blocks per second ______ B1

Average block size for local-to-remote traffic ______ B2

Average input rate (remote-to-local) in blocks per second ______ B3

Average block size for remote-to-local traffic ______ B4

Speed of local/remote communication link (bps) ÷ 8 ______ B5

Calculate Value B: Value B

((B1 x (B2 + 23)) + (B3 x (B4 + 23)))/ B5 = $\square$

Step C - Ratio of Traffic Transmitted by the Remote Communications Controller to Total Traffic on the Local/Remote Communication Link

Calculate Value C: Value C

(B3 x (B4 + 23))/((B1 x (B2 + 23))
+ (B3 x (B4 + 23)))= $\square$

Step D - Average Number of Blocks Queued in the Local Communications Controller for this Local/Remote Communication Link

Use the graph in Figure C-1 to find Value D.

If Value D lies between two curves, use the higher value. Value D

$\square$

Step E - Number of Bytes of Buffer Storage Needed for this Local/Remote Communication Link

Calculate Value E: Value E

Value A x Value D x A2 = $\square$

(2) Local Communications Controller Estimates—Duplex Link

Step A - Number of Buffers per Block

Average block size for local-to-remote traffic on the local/remote communication link ______ A1

Value specified in the BFRS operand of the BUILD macro for the local NCP, rounded up to the nearest multiple of 4, plus 4 ______ A2

Calculate Value A: Value A

(A1 + 30)/(A2 - 4) (round up to next integer) = □

Step B - Utilization for the Local-to-Remote Leg of the Local/Remote Communication Link

Average output rate (local-to-remote in blocks per second ______ B1

Average block size for local-to-remote traffic ______ B2

Speed of local/remote communication link (bps)/8 ______ B3

Calculate Value B: Value B

(B1 x (B2 + 23))/ B3 = □

Step C - Average Number of Blocks Queued in the Local Communications Controller for this Local/Remote Communication Link

Use the graph in Figure C-1 to find Value C. Value C □

Step D - Number of Bytes of Buffer Storage Needed for this Local/Remote Communication Link

Calculate Value D: Value D

Value A x Value C x A2 = □

(3) Remote Communications Controller Estimates—Half-Duplex Link

Step A - Number of Buffers per Block

Average block size for remote-to-local traffic on the local/remote communication link _____ A1

Value specified in the BFRS operand of the BUILD macro for the remote NCP, rounded up to the nearest multiple of 4, plus 4 _____ A2

Calculate Value A: | Value A

(A1 + 30)/(A2 - 4) (round up to next integer) = $\square$

Step B - Total Utilization of Local/Remote Communication Link

Average output rate (local-to-remote) in blocks per second _____ B1

Average block size for local-to-remote traffic _____ B2

Average input rate (remote-to-local) in blocks per second _____ B3

Average block size for remote-to-local traffic _____ B4

Speed of local/remote communication link (bps)/8 _____ B5

Calculate Value B: | Value B

((B1 x (B2 + 23)) + (B3 x (B4 + 23)))/ B5 = $\square$

Step C - Ratio of Traffic Transmitted by the Remote Communication Controller to Total Traffic on the Local/Remote Communication Link

Calculate Value C: | Value C

(B3 x (B4 + 23))/((B1 x (B2 + 23))
+ (B3 x (B4 + 23))) = $\square$

Step D - Average Number of Blocks Queued in the Remote Communications Controller for the Local/Remote Communication Link

Use the graph in Figure C-1 to find Value D.

If Value D lies between two curves, use the higher value. Value D □

Step E - Number of Bytes of Buffer Storage Needed for the Local/Remote Communication Link

Calculate Value E: Value E □

Value A x Value D x A2 =

(4) Remote Communications Controller Estimates—Duplex Link

Step A - Number of Buffers per Block

Average block size for remote-to-local traffic on the local/remote communication link _____ A1

Value specified in the BFRS operand of the BUILD macro for the remote NCP, rounded up to the nearest multiple of 4, plus 4 _____ A2

Calculate Value A: Value A □

(A1 + 30)/(A2 - 4) (round up to next integer) =

Step B - Utilization for the Remote-to-Local Leg of the Local/Remote Communication Link

Average input rate (remote-to-local) in blocks per second _____ B1

Average block size for remote-to-local traffic _____ B2

Speed of local/remote communication link (bps)/8 _____ B3

Calculate Value B: Value B □

(B1 x (B2 + 23))/ B3 =

Step C - Average Number of Blocks Queued in the Remote Communications Controller for the Local/Remote Communication Link

Use the graph in Figure C-1 to find Value C.

Value C

$\square$

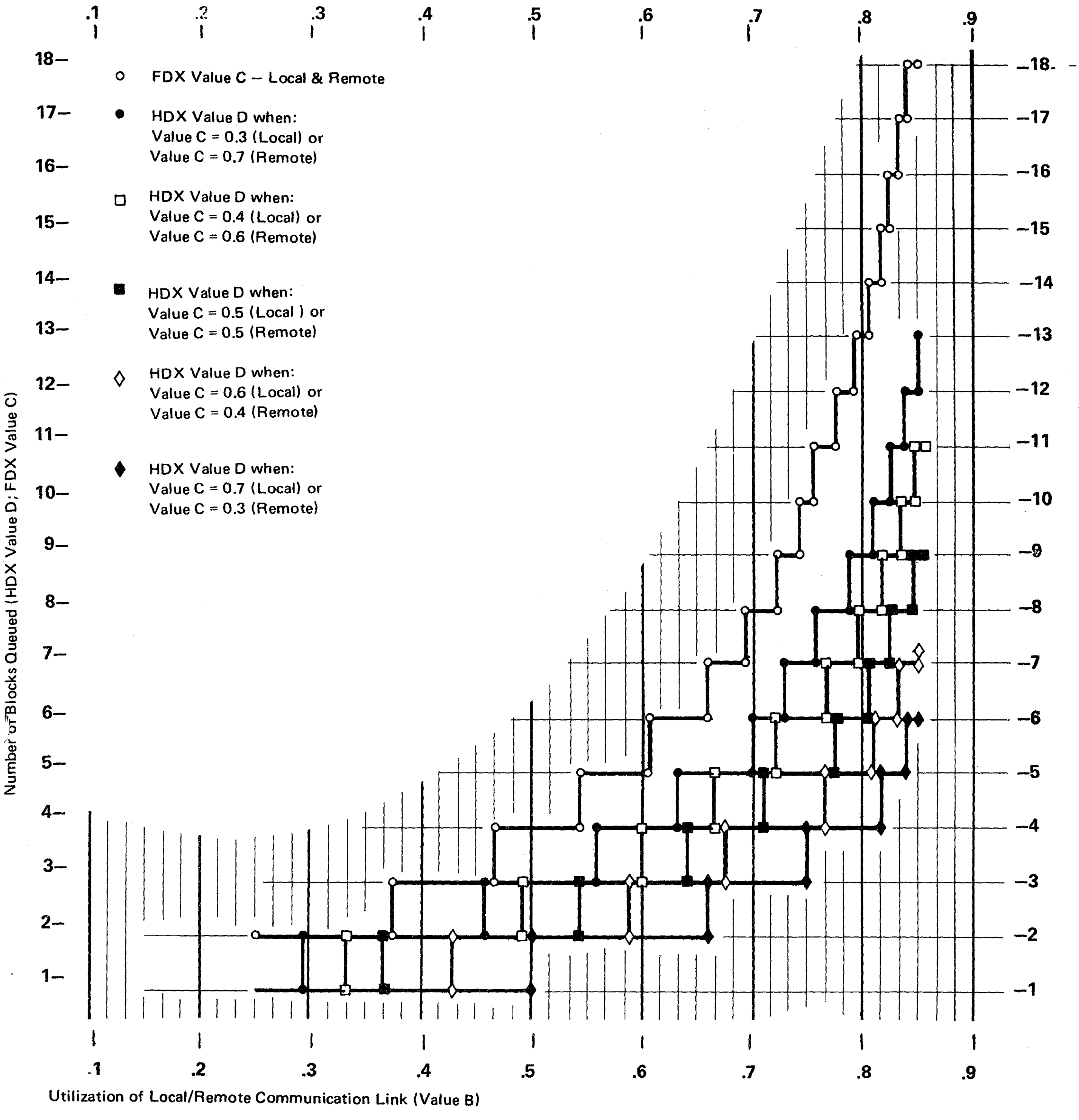
Step D - Number of Bytes of Buffer Storage Needed for the Local/Remote Communication Link

Calculate Value D:

Value D

Value A x Value C x A2 =

$\square$



Note: The following formulas were used to derive the curves in this graph. You may use these formulas instead of the graph if you desire more precise calculations.

For FDX Value C:

[(Log$_{10}$0.05) / (Log$_{10}$Value B)] - 1

For HDX Value D for the local end:

[(Log$_{10}$0.05) / (Log$_{10}$[(Value B × (1 - Value C)) / (1 - (Value B × Value C))])] - 1

For HDX Value D for the remote end:

[(Log$_{10}$0.05) / (Log$_{10}$[(Value B × Value C) / (1 - (Value B × (1 - Value C)))])] - 1

Figure C-1. Number of Blocks Queued for the Local/Remote Communication Link Versus Utilization of the Link

Example of Buffer Storage Calculation for a Local/Remote Communication Link

Calculate the buffer storage estimates for a 7200 bps, half-duplex local/remote communication link, using the following values for the variables.

For the local communications controller:

A1 = 100 characters (average local-to-remote block size)

A2 = 64 buffer size (for BFRS value of 60)

B1 = 4 blocks per second

B2 = 100 characters (average local-to-remote block size)

B3 = 4 blocks per second

B4 = 40 characters (average remote-to-local block size)

B5 = 900 (7200 bps/8)

For the remote communications controller:

A1 = 40 characters (average remote-to-local block size)

A2 = 64 buffer size (for BFRS value of 60)

B1 = 4 blocks per second

B2 = 100 characters (average local-to-remote block size)

B3 = 4 blocks per second

B4 = 40 characters (average remote-to-local block size)

B5 = 900 (7200 bps/8)

Using these values, calculate the buffer storage estimates as follows.

For the local communications controller (using first group of formulas):

Step A:

(100 + 30)/(64 - 4) = 2.2 — Value A

Round up to next integer. = $\boxed{3}$

Step B:

((4 x (100 + 23)) + (4 x (40 + 23)))/900 — Value B

= (492 + 252)/900 = $\boxed{.826}$

Step C:

(4 x (40 + 23))/(4 x (100 + 23)) + (4 x (40 + 23))) Value C

= 252/744 = $\boxed{.34}$

Step D:

Using the graph in Figure C-1, Value D lies between 9 (curve for Value C = 0.4) and 10 (curve for Value C = 0.3). Use the higher value. Value D = $\boxed{10}$

Step E:

3 x 10 x 64 Value E = $\boxed{1920}$

Thus, 1920 bytes of buffer storage are required in the local communications controller for this local/remote communication link. When you determine the storage requirement for the local communications controller, add in this figure.

For the remote communications controller (using third group of formulas):

Step A:

(40 + 30)/(64 - 4) = 1.2 Value A

Round up to next integer. = $\boxed{2}$

Step B:

((4 x (100 + 23)) + (4 x (40 + 23)))/900 Value B

= (492 + 252)/900 = $\boxed{.826}$

Step C:

(4 x (40 + 23))/(4 x (100 + 23)) + (4 x (40 + 23))) Value C

= 252/744 = $\boxed{.34}$

Step D:

Using the graph in Figure C-1, Value D lies between 5 (curve for Value C = 0.3) and 6 (curve for Value C = 0.4). Use the higher value. Value D = $\boxed{6}$

Step E:

2 x 6 x 64 Value E = $\boxed{768}$

Thus, 768 bytes of buffer storage are required in the remote communications controller for this local/remote communication link. When you determine the storage requirement for the remote communications controller, add in this figure.

Glossary

access method: A data management technique for transferring data between main storage and an input/output device.

addressing: The means whereby the originator or control unit selects the teleprocessing device to which it is going to send a message.

address trace: A service aid by which the contents of selected areas of communications controller storage and selected external registers can be recorded at each successive interrupt.

block: The smallest data unit recognized by the communications controller. For start-stop devices, a unit of data between two EOB characters; for BSC devices, a unit between two ETB or ETX characters.

block handling routine (BHR): A routine that performs a single processing function for a block of data passing through the network control program. A typical BHR function is inserting the date and time of day in the block.

buffer: A temporary storage area for data.

buffer pad characters: A sequence of characters that the network control program sends to an access method buffer preceding message data to allow space for the access method to insert message prefixes.

channel transfer unit (CTU): The amount of data transferred to or from the host processor by a single start I/O.

channel adapter (CA): A communications controller hardware unit that provides attachment of the 3704 or 3705 to a System/360 or System/370 I/O channel.

checkpoint/restart: A facility that allows a program to return to a previous point and resume execution there on the basis of information stored at that point when execution was suspended.

cluster: A station that consists of a control unit and the terminals attached to it.

communication scanner: A communications controller hardware unit that provides the connection between line interface bases and the central control unit. The communication scanner monitors the communication lines for service requests.

Control command: A network control program command by which the access method requests that the network control program perform a dynamic control function for the teleprocessing subsystem. The particular function is specified by a modifier of the Control command.

emulation program (EP): A control program that allows a local 3704 or 3705 to operate functionally as an IBM 2701 Data Adapter Unit, and IBM 2702 Transmission Control, an IBM 2703 Transmission Control, or any combination of the three.

host processor: The central processing unit to which the communications controller is attached by a channel and that executes the teleprocessing access method that supports the controller.

interrupt: A halt in processing that allows processing to be resumed at the place it left off.

interrupt priority: The order in which the network control program processes interrupts received simultaneously from two or more communication lines.

line control character: A special character that controls transmission of data over a communication line. For example, line control characters are used to start or end a transmission, to cause transmission-error checking to be performed, and to indicate whether a station has data to send or is ready to receive data.

line scanner: *See* communication scanner.

local communications controller: A communications controller attached to a CPU (the host processor) by a channel adapter.

logical unit: An application program within an SDLC cluster controller, represented within the NCP by an LU macro instruction.

message: For BSC devices, the data unit from the beginning of the transmission to the first ETX character, or between two ETX characters; for start-stop devices, *message* and *transmission* have the same meaning.

network control program (NCP): A control program for the 3704 and 3705, generated by the user from a library of IBM-supplied modules.

online terminal testing: A diagnostic aid by which a terminal or console may request any of several kinds of tests to be performed upon either the same terminal or console or a different one.

pacing: A means for limiting the number of path information units (PIU) sent to a logical unit on an SDLC link until the logical unit acknowledges its ability to receive more PIUs. Use of this option can prevent needless transmission of PIUs to a logical unit before it is ready to receive them.

partitioned emulation programming (PEP): A feature of the network control program/VS that allows a local 3704 or 3705 to operate as an IBM 2701, 2702, 2703 control unit (or any combination of the three) for certain communication lines, while performing network control functions for other lines in the teleprocessing network.

path information unit: The basic unit of transmission in a teleprocessing network. Path information units may request a particular teleprocessing operation (request PIU) or indicate the results of an operation (response PIU).

pause-retry: A network control program option that allows the user to specify how many times the network control program should try to retransmit data after a transmission error occurs, and how long the network control program should wait between each attempt.

polling: A technique by which each of the teleprocessing devices sharing a communication line is interrogated to determine whether it has data to send.

remote communications controller: A communications controller that communicates over a communications line with a local communications controller, instead of being attached directly to the host processor by a channel adapter.

request: A directive from the access method that causes the network control program to perform a data transfer operation or auxiliary operation.

response: The data the network control program sends to the access method, usually in answer to a request received from the access method. Some responses, however, result from conditions occurring within the network control program, such as accumulation of error statistics.

SDLC link: A communications facility over which communications are conducted using the synchronous data link control (SDLC) scheme.

service order table: The list of teleprocessing devices on a multipoint line (or nonswitched point-to-point line where the terminal has multiple components) in the order in which they are to be serviced by the network control program.

service seeking: The process by which the network control program interrogates teleprocessing devices on a multipoint line (or a nonswitched point-to-point line where the terminal has multiple components) for requests to send data or for readiness to receive data.

service-seeking pause: A user-specified interval between successive attempts at service seeking on a line when all teleprocessing devices on the line are responding negatively to polling.

session: A series of command and data interchanges between the host processor and a teleprocessing device.

session limit: The maximum number of concurrent sessions that can be initiated on a multipoint line (or point-to-point line where the terminal has multiple components).

station: A point in a teleprocessing network at which data can either enter or leave.

subchannel: The channel facility required for sustaining a single I/O operation.

synchronous data link control (SDLC): A discipline for the management of information transfer over a data communications facility.

teleprocessing: A form of information handling in which a data processing system utilizes communication facilities.

teleprocessing device: A unit of teleprocessing equipment connected to the communications controller via a communication line and identified as a cluster, terminal, or component at control program generation time.

teleprocessing network: The stations that are controlled by a single access method (or, in the communications controller, by a single network control program), and the communication lines by which they are connected to the transmission control unit.

teleprocessing subsystem: The part of a data processing system devoted to the transfer of data across communication lines. The subsystem consists of the stations, data sets (or modems), communication lines, and the transmission control unit.

terminal: A teleprocessing device capable of transmitting or receiving data (or both) over a communication line.

trace table: An area within the network control program into which address trace information is placed.

transmission code: The character code used for data transmissions across a communication line.

transmission control unit (TCU): A unit that provides the interface between communication lines and a computer. The TCU interleaves the transfer of data from many lines across a single channel to the computer.

transmission limit: The maximum number of transmissions that can be sent to or received from a teleprocessing device during one session on a multipoint line (or point-to-point line where the terminal has multiple components) before the network control program suspends the session to service other devices.

user block handling routine: A block handling routine coded by the user and added to the network control program during program generation.

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